Civil Engineering and Contracting

APRIL 1, 1920

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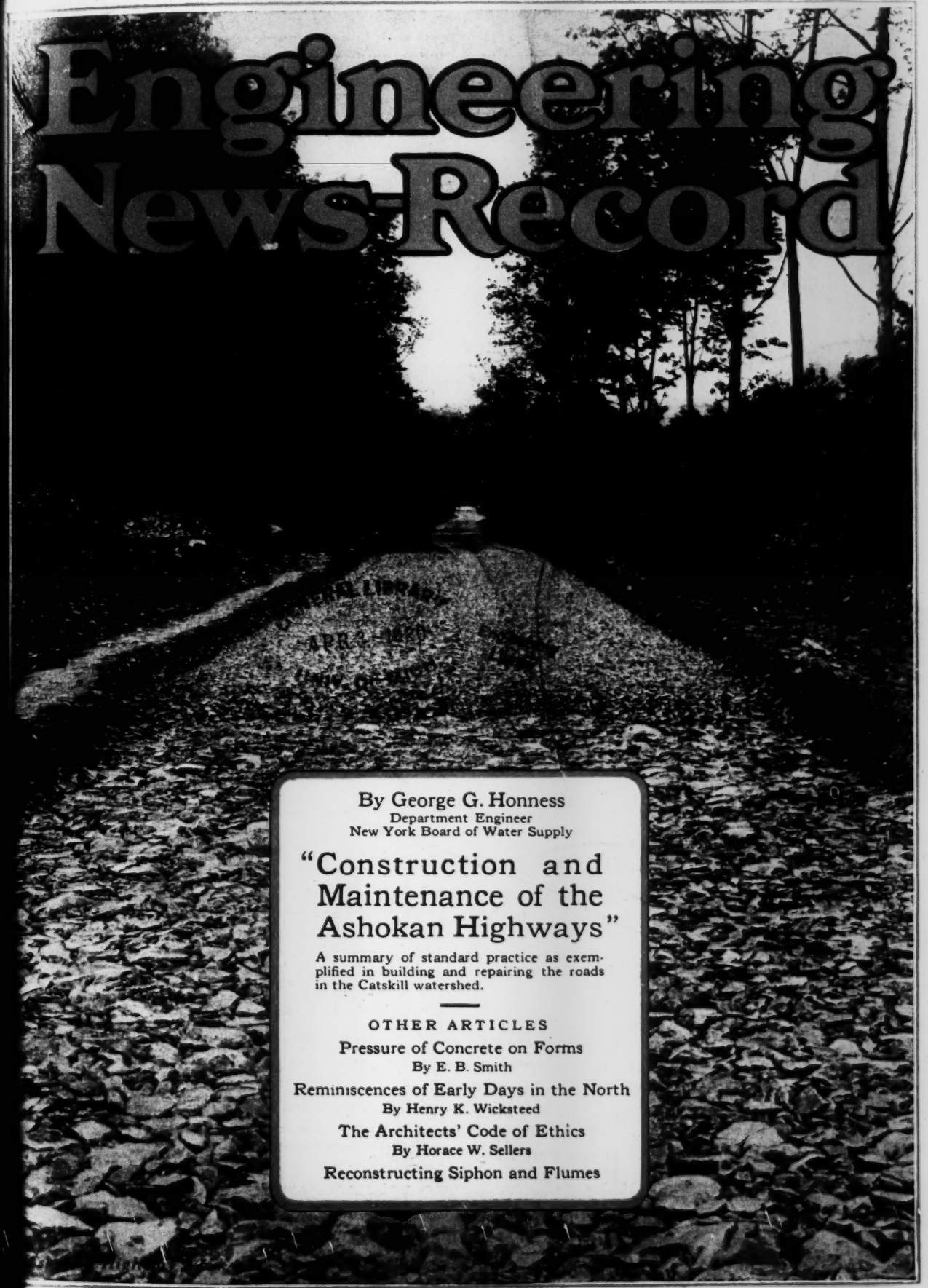
Engineering News-Record



By George G. Honness
Department Engineer
New York Board of Water Supply

"Construction and Maintenance of the Ashokan Highways"

A summary of standard practice as exemplified in building and repairing the roads in the Catskill watershed.

OTHER ARTICLES

Pressure of Concrete on Forms
By E. B. Smith

Reminiscences of Early Days in the North
By Henry K. Wicksteed

The Architects' Code of Ethics
By Horace W. Sellers

Reconstructing Siphon and Flumes

View — Kreolite Lug Wood Block Pavement, Central Avenue, Cincinnati, O.

The Value of Street Improvement— with

KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"

The value of a street improvement in the increase in volume of traffic is strikingly illustrated by figures submitted to City Engineer Frank Krug Wednesday, by H. F. Shipley, principal assistant engineer, in reporting the results of a traffic survey made on Central avenue during the week ending November 29.

The report is accompanied by a comparison with a survey made at the same points during the corresponding period of 1918, before the street was repaved. An observer stationed on Central avenue between Fifth street and Carlisle avenue counted 2,786 vehicles (504 horse-drawn and 2,282 motor) pass there within the period of one work day.

The observation made at the same point last year, before the improvement, showed only 730 vehicles passing there in the course of a day. Other observations were as follows

	1919	1918
Central Avenue, between Eighth and Ninth,	3,790	2,162
Central Avenue, between Elizabeth and Clark	3,100	624
Central Avenue, between Clark and Hopkins	3,188	651
Central Avenue, between Clinton Street and Armory Avenue	2,813	411
Central Avenue, between Armory and David,	2,647	473

In this year's count the motor-driven vehicles outnumbered the horse-drawn by nearly 6 to 1.
—Cincinnati Times Star.

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. Mehren
Editor

Volume 84 — NEW YORK, THURSDAY, APRIL 1, 1920 — Number 14

Last Call for Votes

THE questionnaire ballot of the American Society of Civil Engineers is to be canvassed April 16. Those who have not yet voted should do so at once. Despite the fact that the questions at issue have been before the members more or less actively for many years, the number of votes cast up to March 29 was only 2,359, about 25 per cent of the membership. The present ballot, which will determine the course of the society for many a year, should bring out an overwhelming expression. Shall it be that the society's course will be determined in a ballot in which less than one-third of the members vote? We hold it to be a solemn duty of every member to play his part in determining the society's future.

A Final Word

WE HAVE been glad while the questionnaire ballot has been under consideration to afford a free forum in our Letters' column for the discussion of the issues. If the communications are an index of the thinking of the membership at large, there is only one doubtful point—whether the society should join with the other national bodies in effecting a comprehensive organization of the profession. The internal changes proposed by the committee on development seem to be generally approved. With reference to Question 3, most of the letters' pertinent thereto which we have printed have opposed the comprehensive-organization plan. If this were a correct index of the society's thinking, it would indicate the defeat of the proposal. Reference to Mr. Humphrey's letter in the News Section of this issue, though, will show that outside of New York sentiment is strongly in favor of the joint committee's proposal. No less than twenty of the local groups of members have approved the proposal. The letters we have published have come chiefly from New York—the traditional home of society conservatism. That should be carefully remembered by those who would weigh the significance of the opposition to Question 3.

Enforcing Codes of Ethics

WE HEAR so often the view that codes of ethics cannot be enforced that it is a distinct pleasure to read the article on the disciplinary procedure of the American Institute of Architects on p. 677 of this issue. The architects not only have a code, but they have machinery for its enforcement and penalties for its violation. Further, they use the machinery and they impose the penalties. We hope that every civil engineer will read Mr. Sellers' article carefully, and that it will be brought to the attention of the profession generally. Representatives of the American Society of Mechanical Engineers in the Joint Committee conferences enunciated heretical views regarding codes of ethics. Apparently, they would say to the enforcement procedure of the architects, "There ain't no such animal." But the architects have enforced their code. Shall the engineers continue to let theirs remain unapplied?

Schwab on Success in Life

WHILE Charles M. Schwab's recent address on success in life, delivered to the undergraduates of Princeton, was essentially a message to young men and has been reproduced in large part in this issue (p. 681) mainly for the benefit of the young engineer, it contains so many valuable hints on organization and on the handling of men that every engineer will profit by giving it a careful reading. Two characteristics of Mr. Schwab stand out in almost every paragraph: he understands men and he is an optimist. We feel, after reading his words, that he is the type of man we would like to work with. This type of executive, unfortunately, is not as common among technically trained men as one would wish. If there were more engineers of that type, there would be less complaint about inadequacy of compensation or lack of appreciation by the public.

Co-operation of Highway Agencies

LARGE possibilities are latent in the practice which the highway officials of a number of states have inaugurated of calling annual conferences of the agencies concerned in the construction of improved highways. The task of standardizing cost-estimating which has been undertaken in Wisconsin is an example. At the call of the state highway engineer a conference, participated in by nearly 300 engineers, contractors, materials producers and equipment manufacturers, was held in November, 1919. The standardizing committee grew from this conference. This is but one of the many kinds of co-operative work that may profitably be undertaken. The plan should be followed in every state. The task ahead is stupendous and conferences will help develop a confidence that will be of immeasurable value.

New Plans for Hetch Hetchy

IN INVITING contractors to bid on the 18-mile tunnel on the Hetch Hetchy project, San Francisco has resorted to what seems the only logical course under present financial conditions. The bond situation was commented on in an editorial appearing in our March 11 issue, page 498. When the city called for bids on this work, in 1917, the lowest bid for concrete-lined tunnel was $95 per lineal foot. This was so far above the engineers' estimate of $63 per foot that all bids were rejected and the city undertook to do the work on the day-labor plan. The *Engineering News-Record* at the time expressed doubt that the work could be done for

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this figure, but the city engineer, M. M. O'Shaughnessy, after driving two miles of tunnel, has stated that the cost has been $40 per foot, exclusive of the lining, which he estimates can be done for $20 per foot. Allowing $5 for contingencies, the total would be $65 per foot, only $2 above the original estimate. With five headings open and two miles of tunnel driven, there are data available on which contractors should be able to make a much more accurate estimate of cost than at the first bidding, particularly as they can figure on using the equipment and, to a large extent, the organization now on the job. In other words, the number of uncertain elements involved has been reduced. The fluctuations in the money market and the labor situation, however, continue to be factors on which no assurance of future conditions can be had, and it is likely that at the present bond-discount rate the financing may add $20 per foot to the cost.

Hetch Hetchy Power

SIMULTANEOUSLY with the decision to call for bids on the Hetch Hetchy tunnel work comes a suggestion that the surplus power should be sold, when ready, to private power companies. There is much criticism in California against building the Hetch Hetchy aqueduct now, when the purpose seems to be to develop power rather than to secure a municipal water supply. Objections are made by irrigation interests, and also by those who fear the competition between the municipality and public-utility companies. The latter objection is removed by the fact that the city has already received offers from private parties for the purchase of the surplus energy from the aqueduct. As to the rights of the irrigationists, they are already protected by the law. With successive years of drought in California, the increasing price of oil and the rapidly growing demand for electrical energy, there seems no reason why the city, with this water placed at its disposal by the Government, should not help the power situation, and at the same time help itself to pay for the building of the aqueduct, which, all agree, will eventually be needed for the city's water supply. Legal objections are also raised, but the city has sold surplus power from its construction plant for a year or more, while Los Angeles has found it possible to sell aqueduct power. Even though the water may not be needed for city supply for some time to come, conditions in California warrant the pushing of the Hetch Hetchy work.

Highway Classification

COINCIDENT with the announcement of the plan undertaken by the Bureau of Public Roads for the classification of highways, comes the word from England that the Director General of Roads, under the Ministry of Transport and with the collaboration of the Roads Advisory Committee, is undertaking similar work there. Though the basis of classification in either country—the relative importance of various highways for general traffic purposes is the same, England must, of necessity, proceed in greater detail. Traffic censuses at all strategic points on all highways are to assist in the British classification. The most careful analysis of expenditures and receipts is demanded to assist the Ministry of Transport in determining what the percentage of maintenance grants shall be. However more in detail the British classification goes, the principle underlying either classification is the same—the determination of local, regional, and national value as a means of regulating county, state and Federal appropriation for highway construction and maintenance.

Cost Analysis of Road Work

IMPORTANT work has been done by the highway engineers and contractors of Wisconsin in standardizing cost-estimating practices. The immediate value of this work lies in the lists of cost items which are published on p. 663. These lists may be used in preparing, or for checking, cost estimates without regard to their further development. Necessarily, there will be further benefit as the procedures are perfected and the use of the methods becomes general. As an example, more precise computation and distribution of costs will follow. Bidding prices will, in consequence, be based on facts and not on assumptions. Finally, engineers and contractors will learn to think along parallel instead of divergent lines on questions of cost. This is the purpose sought by the co-operative work now being carried on.

More Reclamation Needed

SOONER or later enabling legislation will permit the engineer to provide this country with more farms. Economic necessity will force it. A large grist of bills has been presented to Congress in the past year but none seems to have had more than educational effect. The engineer, who is inclined to support some one of these bills, may fortify his own enthusiasm by emphasizing Herbert Hoover's recent statement before the Western Society of Engineers that we would be importing food within five years. Moreover, D. W. Ross, in a statement in relation to the Fletcher-Smith land reclamation bill, S. 3942 and H. R. 12649, gave statistics as to our needs. The farmers are increasing at the rate of 700,000 per year. They need 100,000 new farms or 6,000,000 acres. Only 2,000,000 acres have been put under irrigation by the Reclamation Service and with present funds only 2,500,000 acres more will be available—not, however, within the next year, but in the next 25 years. The great proportion of the 10,000,000 persons representing the natural increase in the farming population since the Reclamation Act became operative has found economic independence easier to obtain in other industries. The difficulty of obtaining a foothold upon the soil is due chiefly to the $30,000,000,000 advance in the price of farm land in this 18-year period. The events of the past five years, which have developed a fierce competition for man-power gave this cityward movement a further impetus. In another 10 years the total increase in population will be 20,000,000; the increase from the farm population will be 6,000,000. How to divert a small portion back to the land or to retard the movement to the cities so that all of us may eat is a serious problem to which the engineer may well lend his help.

Ambitious Legislation

THE Fletcher-Smith bill noted above is an ambitious all-inclusive $350,000,000 reclamation measure introduced by the southern interests, to which western support has been given because it is a modification of the Smith-Chamberlain bill which has been before Con-

gress for several sessions. The financial scheme, accomplished through the medium of the district, is along the lines suggested by the western interests but the projects would be placed on an interest-paying basis. The essential features are based upon the joint credit of the Government and the states, the investing public furnishing the funds. Like the Federal Farm Loan System it would lay no burden upon the taxpayer. In its favor are the utilization of the present U. S. Reclamation Service, the small beginning and the interest-paying feature.

Budgeting Construction to Available Labor and Materials Supply

NEWS reports from England indicate that the Ministry of Health is about to place restrictions upon so-called luxury construction. The proposed regulations will allow local authorities to determine within their respective areas whether any proposed building will delay housing and to indicate priority, when necessary, in building construction. It is probable that these provisions will become effective immediately.

Such restrictions as England proposes and such regulation of construction as is outlined are a needed step toward the correction of a condition which four years of war has created—lack of housing. It is a condition which has made itself keenly felt in this country as well. Cannot we find in the British proposal enough merit to warrant our taking similar action in order that we may in part, at least, correct a very serious condition—one that very properly should give us national concern?

Architects, engineers, and contractors are now engaged in large numbers on three classes of work: industrial plants, highways and general construction. The amount of industrial construction undertaken is large and there is little doubt that such construction is not for immediate need, but is undertaken because funds are available that would otherwise go to the Government as excess profits taxes. In any event, industrial construction is in large volume and to a large extent is controlling the materials and labor markets.

The roadbuilding program must be curtailed. With a restriction of industrial construction to the necessary, and a considerable reduction in the road program, there would be released for general construction, and particularly for housing, a nearly normal supply of material and labor. In the City of New York alone it is estimated that 40,000 apartments per year are needed to care for the increasing population. At the minimum it is two years behind in its housing construction. It is also estimated that in New York City there is available from $50,000,000 to $100,000,000 worth of credit for housing schemes. But private owners are unwilling in a short market to compete with large industries.

Happily or unhappily there exists in these United States no agency which is the conterpart of the Ministry of Health in England to assume charge of construction administration. Doubtless there are many in this country who recoil from so "social" a program as the Ministry of Health is engaging upon. There are many among us who would fight any attempt to curb individual effort or to restrict the expenditure of private funds. But whether it smacks of socialism or not, what the Ministry of Health proposes to do is corrective. If we have no agency analogous to the Ministry of Health we can at least engage the attention and perhaps sympathies of those agencies which combine to turn capital into construction. We need a budget that will prorate construction to the available supply of materials and labor, taking care, first of all, of such enterprises as will relieve the living conditions of hundreds of thousands of our metropolitan population. Such co-ordination will mean the yielding a little of all agencies concerned; the contractor who has upon his books large amounts of industrial contracts, the manufacturer whose excessive profits are turned into construction, the material dealers, organized labor, the banks who furnish credit, the real estate brokers,—in short, every agency concerned.

Inasmuch as it ruffles the average American to suggest restriction or regulation from any outside agency, this budgeting of construction to available supply of materials and labor must be a product of private co-operation. The Government or the U. S. Chamber of Commerce should take the initiative.

Broadminded business judgment requires such action. If voluntary co-operation fails we may soon have to censent to compulsory restriction. The housing situation is critical.

An Engineer for the Hall of Fame

WHAT are engineers doing to secure a place in the Hall of Fame? The fifth quinquennial election takes place this year. Any one may send nominations to the Hall of Fame, New York University, New York City, up to May 1, for reference to the electors who make the final choice. Among the electors this year is Gen. George W. Goethals. The nominees are divided into 15 classes, including scientists, physicians and sugeons, engineers and architects, inventors, and business men. Thus far, the scientists and the inv ntors have four representatives each in the Hall of Fame, but there are none for engineers and architects, physicians and surgeons, or business men. The only engineer who has received a large number of votes—only to fail of choice by the electors—is James B. Eads.

Surely at least one of the many great engineers of the country, now ten years deceased, comes within the definition of fame that guides the electors, that is: "The condition of being much talked about, chiefly in a good sense; or reputation from good achievements." Engineers individually and every national, state and local engineering society should bestir themselves in this matter without a moment's delay—not merely to ensure proper consideration of the claims of engineers for recognition, but also because the great aim of the Hall of Fame is educational and inspirational. A special effort is being made to interest the schools and colleges of the country, a significant fact for the engineering schools.

Should it prove to be too late to get effective action at the 1920 election then the subject might well be kept before the engineers and engineering societies of the country during the next five years. It should be remembered that normally only ten new tablets are put up once in five years, of which two are for women. Obviously much needs to be done to bring the claims of worthy engineers to such wide popular recognition as they reserve, and at the same time to crystallize and center, first engineering, then public opinion upon a small enough number of engineers to ensure the election of one. To get results prompt action is needed.

Construction and Maintenance of the Ashokan Highways

Deep Frost Penetration Causes Curling of Edges and Transverse and Longitudinal Cracks — Elasticity of Slab Allows Automatic Healing When Ground Thaws

By George G. Honness
Department Engineer Board of Water Supply, City of New York

THE Ashokan reservoir, located in the foothills of the Catskill Mountains, and the principal impounding reservoir for New York's Catskill water supply, is the largest reservoir for potable water in the world. Its creation necessitated the construction of about 40 mi. of new highways as substitutes for highways included within the reservoir area. There were about 68 mi. of these old roads and they were mainly ordinary dirt roads with little provision for drainage, and practically no protection in the way of guard rails. The new highways are relocated for their entire lengths, generally through an extremely rough country. The location was practically limited to a strip of country 500 ft. wide, as the rule was laid down that in general the highways should not approach the reservoir shore line nearer than 500 ft. nor depart from it more than 1,000 ft. With the final location made, a strip of land varying in width from 66 to 100 ft. was set aside for highway purposes. In a few places, because of topographical conditions, it was impractical to follow the above outlined plan, but such places aggregated a small part of the entire highway system.

An attempt was made to limit the maximum grade to 5 per cent, and how well this was accomplished is shown by the fact that there was only a little more than 3,000 ft. of grade in excess of 5 per cent, and of 5 per cent grade only about 2¼ mi. These roads were located in 1906, before the use of automobiles had become so geenral, and for that reason not as much attention was given to alignment as would be given today. At a number of places there are curves of a too short radius, and a slight increase in cost for grading would have improved the conditions materially.

In order that embankments should be given an opportunity to reach final settlement, the grading was undertaken several years in advance of the time of surfacing; this also gave opportunity to note conditions of high groundwater and deep frost penetration, and advantage was taken of this opportunity during at least three spring seasons before surfacing was undertaken. The drainage problem was thereby simplified and advance knowledge was gained of the portions of the road needing special treatment.

Grading

The roadway was 28 ft. wide in cuts and 24 ft. wide on embankments, guard rails being set so as to give an unobstructed roadway 22 ft. wide. The rock of this region is of the Hudson River series of sandstones and shales, and the earth is glacial drift, much of it a heavy clay soil, which continues to absorb moisture until it runs like a heavy molasses and admits of an unusually deep frost penetration. In this mountain country there are frequently summer days when the temperature approaches 100 deg. F. and in the winter it is not unusual to have temperatures of 20 deg. F. below zero. Frost has been known to penetrate in excess of 5 ft. Ordinarily there are heavy falls of snow which prevent the deep frost penetration, but occasionally this is not the case and the effect on the roads in the spring is very severe and will be commented upon later in this article.

The average yardage of excavation was 2.41 cu. yd. per linear foot, of which 22.8 per cent was rock. This quantity varied from 2.12 cu. yd. to 3.67 cu. yd. per linear foot and the percentage of rock from 0.3 per cent to 41.6 per cent. About 10 mi. of the highway was in rock cut or fills, but the balance was in the heavy, tough clay already described.

The average contract cost for grading wass $13,931.54 per mile.

A court order fixed the widths of the surfacing at 16 ft. on the north side and 14 ft. on the south side of the reservoir and required that the surface of the new roads be "equal in every respect to those constructed by the State of New York in the County of Ulster." On previous work done by the City of New York in upstate counties it has been the practice to award the various towns a lump sum for maintaining the new highways. This is a capital sum, the interest from which is supposed to represent the difference in yearly cost of maintenance of the old and new highways. The city has no control over the expenditure of this money. The alternative is for the city to maintain the roads forever. In this instance, the corporation counsel decided upon the latter course.

Extensive studies were made of the relative merits of various types of surfacing. With the condition of perpetual maintenance in mind, it was decided that a vitrified-brick pavement on a concrete foundation would be most suitable. A contract was prepared and bids received in 1913, but objections were raised by the finance department and the Board of Estimate and Apportionment to this seeming extravagance, so that in May, 1913, all bids for brick paving were rejected. The Board of Estimate's committee of consulting engineers recommended that the majority of the roads be surfaced with a mixed bituminous concrete on a foundation course of crushed stone, and a contract was prepared and let in August, 1913.

For highways carried over dams and dikes of the reservoir, vitrified brick on a concrete foundation was used. A short mileage of waterbound macadam, which was later given a surface treatment with hot tar applied with a pressure distributor, was used where traffic was light. Some bridges were paved with asphalt blocks. The relative mileage is as follows:

	Miles
Mixed bituminous concrete	32.11
Vitrified brick on concrete foundation	4.27
Waterbound macadam	2.92
Asphalt blocks	0.71
Total	40.01

As the major portion of the highways are surfaced with mixed bituminous concrete, this article will be limited to a description of the construction and maintenance of that type of pavement.

The contract for the bituminous surfacing was let in August, 1913, and construction completed in the fall

FIG. 1. FOUNDATION AND BASE UNDERLYING 2-IN. ASPHALTIC TOPPING

of 1915, the bulk of the work being done in the season of 1914. The principal items of work were: 24,577 cu. yd. of broken stone for drainage course; 50,015 cu. yd. of broken stone for foundation course; 275,803 sq. yd. of bituminous surfacing; and 2,648 tons of bitumen in asphalt cement. This contract also included items for the maintenance of the surfacing and shoulders for a period of three years beginning Oct. 1 of the season in which the pavement was completed.

It is generally conceded that the success of any pavement is dependent upon the drainage of the subgrade. As previously stated, at least three spring seasons were used to determine the extent to which special treatment was necessary. This record was used when surfacing was undertaken and it was found necessary to modify the previously determined method of construction only to a slight extent. How thoroughly the drainage problem was cared for is evidenced by the following facts: About 10 mi. of this highway were in rock cuts or on fills; about 13 mi. were provided with a properly drained sub-base 8 in. thick, making a total thickness of 16 in., including the 2-in. wearing surface; and about 6¾ mi. of 4-in. tile pipe were used, being laid in a trench 4 ft. below crown grade, the trench being filled with graded crushed stone, where high ground water conditions made this necessary.

To make the subgrade drainage certainly effective, it is essential that the tile drains and drainage course should be free drainage, and this is by no means easy of accomplishment in a climate such as is prevalent in the region in which these roads were built. Ice and hard packed snow frequently close the openings and cause water to back up into the drains and drainage course; therefore, any money expended in gaining a free outlet for ground water is well warranted.

Laying of Drainage Course

A drainage course was used in practically all earth cuts and on some embankments. It was laid on a well prepared subgrade which was carefully trimmed and rolled. Where the drainage course could be drained into side ditches on both sides, the subgrade was made parallel to the finished surface; where this was not practical, it was given a transverse slope toward the side on which drainage was obtainable. A blind outlet was provided at intervals of about 100 ft.

In placing the drainage course, the largest field or quarry stones available were laid on the subgrade with the flat side down. The subgrade was entirely covered with these large flat stones, laid so that they had a solid bearing and did not wave or rock or bridge over from one stone to another. The drainage course was built up with smaller stones and usually topped off with tailings from the crushers, and when ready for rolling had a thickness of about 10 in. which rolled to a thickness of about 8 in. when properly compacted. The rolling was very thoroughly done, as it prevented the stone of the standard foundation course from being rolled into the sub-base.

When the drainage course was not used or required, the foundation course consisted of two layers each 3 in. thick after rolling. The sizes of stone and methods of construction for the standard foundation course were specified as follows:

The screening plant or plants for supplying broken stone for Items 4, 5 and 6 shall be equipped with revolving screens, 0 to 12 ft. long and from 30 to 36 in. in diameter, having perforations as follows: First section, ½-in. holes; second section, 1½-in. holes; third section, 3-in. holes. The sections of screen shall be of acceptable lengths. A dust jacket having ¼-in. circular perforations or composed of a 4-in. mesh screen shall surround the first section; it shall be 6 to 9 in. shorter than the ½-in. screen and about 6 in. greater in diameter. The products of the crushing and screening plants shall be clean and of suitable quality for the purposes intended. Broken stone shall be so handled and transported as to prevent segregation.

Waterbound macadam surfacing shall be constructed as follows: After the subgrade shall have been acceptably prepared, a layer of 3-in. stone shall be spread for the bottom course to such depth that it shall have, when rolled, a thickness of about 5 in. at the center of the road. It shall be thoroughly rolled with a 10- to 12-ton roller, beginning at the edges, until it does not creep or wave ahead of the roller, and shall be carefully constructed to conform to the ordered grade, crown and section. A dry filler of screenings shall then be swept in with brooms, thoroughly sprinkled and rolled, this process being continued until the voids are completely filled. Irregularities or depressions that develop shall be made good. In general, more rolling will be necessary where the foundation is earth than where it is rock. A layer of 1½-in. stone shall then be evenly spread for the top course to such depth that when rolled it will be about 3 in. thick. After thorough rolling, screenings shall be swept in dry, sprinkled and rolled, until a grout shall have been formed that fills all the voids. The finished surface shall be true to the required shape. A thin layer of screenings shall be spread over the road to form a top dressing.

The bottom course of the bituminous pavement shall be constructed as specified in the first part of Section 4.7 for the bottom course of macadam, except that it shall be laid in two layers of about 3 in. each after rolling, each layer to be thoroughly rolled and the voids filled with screenings to the extent directed. When completed, ready for the bituminous wearing course, the surface of the bottom course shall be true to shape, clean, firm and with no loose stones and no excess of screenings. If the surface is not slightly rough so as to afford sufficient bond for the bituminous course it shall be broomed. The bottom course shall not be laid more than 1,000 ft. in advance of the wearing course specified in Item 6.

A very exceptional foundation course was obtained and, after sweeping clean prior to the placing of the wearing surface, was equal in quality to a well-constructed waterbound macadam. This quality, the fact that traffic was apparently beneficial, and the impossibility of maintaining the required progress, made it possible to waive the contract requirement that the foundation course should not be kept more than 1,000 ft. in advance of the wearing surface.

The crown of the finished pavement as shown on the contract drawings was ¼ in. per ft., being 2 in. for a 16-ft. width and 1¾ in. for a 14-ft. width. It was found, shortly after the work started, that this small crowning was hard to obtain and it was increased to ⅜ in. per foot. This increase in crown is not sufficient to lead to concentration of traffic to the center of the pavement and provides better drainage and is easier to attain.

The type of plant used for furnishing the stone for the foundation course and stone for the wearing surface was the typical portable crusher with screens and bins commonly used for highway construction. These plants were set up at intervals of about 1½ mi. and provided sufficient 3-in. stone for the foundation course and, in addition, the 1½-in. stone and chips for the wearing surface and seal coat, although there was some shortage of dust and chips, which made it necessary to operate the crusher for a portion of the time with close set jaws. In order to increase the amount of fine material in the 1½-in. product used for the wearing surface, the lengths of screen were adjusted so that the length of screen having ½-in. holes was 21 in. long and that having 1½-in. holes was 36 in. long, the balance of the screen having 3-inch holes. This type of plant provided sufficient stone to complete 143 lin. ft. of 14-ft. road or 123 ft. of 16-ft. road per day.

Wearing Surface

The bituminous concrete was mixed so that the resulting mixture contained, by weight, 6¼ per cent of asphaltic cement, the stone ranging in size from ½-in. to 1½ in. The temperature of the stone, after drying and heating, was fixed at a maximum of 225 deg. F. and the asphalt ranged from 275 deg. F. to 300 deg. F., as it was found that these temperatures reduced the leakage from the wagons to a minimum.

The detailed specifications for wearing surface follow:

The broken stone for the wearing course shall be heated, before entering the mixer, to between 225 deg. F. and 300 deg. F. in revolving dryers of an approved type, in which no flame shall be permitted to come in contact with the stone. The stone shall be continuously agitated during the heating.

The asphalt cement furnished . . . for the wearing course and the seal coat shall be heated separately from the broken stone in approved receptacles, so designed as to admit of an even heating of the entire mass, with an efficient and positive control of the heat at all times. It shall be heated to the temperature directed from time to time, between 275 deg. F. and 350 deg. F. If any portion of a batch of asphalt cement is heated beyond 350 deg. F., either before or after mixing with the broken stone, the entire batch shall be rejected.

When thoroughly heated to the proper temperatures the asphalt cement and the broken stone for the wearing course shall be mixed, as directed from time to time, generally so that the resulting mixture shall contain between 5 and 7½

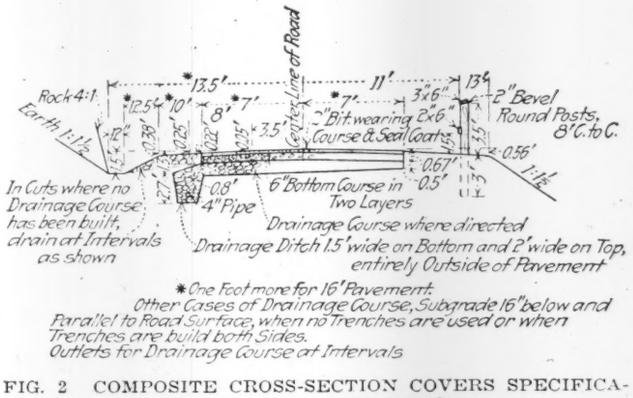


FIG. 2 COMPOSITE CROSS-SECTION COVERS SPECIFICATIONS FOR ALL SECTIONS

per cent, by weight, of bitumen. The contractor shall provide approved means for accurately proportioning the mixture. Excess of asphalt cement shall be prevented; and any such excess shall be cause for rejection of the surfacing unless satisfactorily corrected previous to laying. A mixer shall be used, of satisfactory design, having revolving blades, and efficient means for keeping the temperature at the desired point without burning the asphalt. The mixing shall continue until every particle of the broken stone is thoroughly coated with the asphalt cement and a uniform mixture has been obtained, which when discharged shall have a temperature not more than 300 deg. F. and not less than 225 deg. F. The use of batteries of small batch mixers will not be allowed.

The bituminous mixture, thus heated and prepared, shall be delivered from the mixer to the point of deposition in the pavement, if at a considerable distance, in suitable trucks or wagons, provided with canvas covers for retaining the heat. To prevent undue compacting on long hauls, partitions may be required for large truck loads. As delivered, the mixture shall have a temperature of at least 150 deg. F. Material having a lower temperature than this shall not be laid in the pavement. The mixture shall be immediately spread over the foundation course by men experienced in such work, so that when rolled it shall have a thickness at no place less than 2 in. and shall be free from surface depressions and irregularities. The paving shall be done as continuously as practicable, to reduce to a minimum the number of joints between hot and cold materials. Such joints shall be constructed in an approved manner. The hot paving mixture shall not be dumped in large masses on the bottom course. It shall be dumped onto platforms and shoveled with hot shovels into position in the pavement.

The wearing course . . . shall be rolled at once, while the material is still warm and pliable, beginning at the edges and working toward the center. Acceptable means shall be provided to prevent the asphalt sticking to the roller. Rolling shall continue without interruption until all roller marks disappear and the surface shows no further compressibility. Places which the roller cannot effectively reach shall be compressed with hot iron tampers.

As soon as possible after the completion of the wearing course, when the surface is clean and dry, a seal coat of hot asphalt cement shall be evenly spread over the wearing course with squeegees or by other acceptable method. The asphalt cement shall be applied at a temperature not less than 275 deg. F., nor more than 350 deg. F., at a rate of ½ to ¾ gal. per square yard, as directed. A liberal and uniform layer of dry, clean stone chips shall be immediately spread over the asphalt cement by machines or skilled workmen, sufficient to more than take up all excess of asphalt cement. The spreading of the stone chips shall not lag more than 20 ft. behind the placing of the asphalt coating. The pavement shall be again thoroughly rolled. No stone chips shall be put on the wearing course before the asphalt cement of the seal coat is applied. The surface of the wearing course shall be kept scrupulously clean until the seal coat is applied. The contractor shall not permit any hauling over the wearing surface before the completion of the seal coat.

Before placing the seal coat, the pavement shall be tested with a 2-ft. straight edge laid parallel with the center line of the pavement, and any depression exceeding ½ in. shall be satisfactorily eliminated or the pavement relaid.

Rollers used for the bituminous wearing course and the seal coat shall be well balanced, self-propelled, tandem rollers of satisfactory design, weighing between 8 and 10 tons each. Each shall give a compression under the rear roller of between 200 and 300 lb. per linear inch of roll, and shall be provided with an ash pan, which shall prevent ashes from dropping onto the pavement.

No bituminous surfacing shall be mixed or placed between Oct. 1 and May 15, except by written permission, and no bituminous material shall be mixed or placed when the air temperature in the shade is below 50 deg. F., or when the foundation is damp or otherwise unsatisfactory. The shoulders of the road and adjacent grounds shall be sufficiently sprinkled during the placing of bituminous material wherever there would otherwise be danger of clouds of dust blowing over the pavement.

The "hot stuff" was hauled to the place of laying in bottom-dump wagons which were lined with asbestos and provided with canvas covers, and was dumped onto platforms consisting of planks placed loosely side by side a few feet in advance of the laying. From these it was shoveled into place and spread with rakes to the requisite thickness to secure the required 2-in. thickness after rolling. It was found that the compression due to rolling with an 8-ton tandem roller was generally ⅝ in. to ¾ in. After rolling, a seal coat, not to exceed 1 gal. per square yard, was spread and covered with stone chips. The dry stone chips were spread in two operations. The first spreading was very light, and the rolling resulted in forcing the chips into the seal coat between the interstices of the coated stones of the wearing surface. After a thorough rolling, a more liberal coating of stone chips was spread and rolled.

The asphalt cement was paid for separately and was based on the percentage of bitumen in the cement, and no asphalt was accepted which contained less than 99.7 per cent bitumen. The amount of asphaltic cement, including seal coat, averaged 19.2 lb. or 2.3 gal. per square yard of road surfaced.

Construction Costs

The asphalt plants consisted of dryers for stone, kettles for heating asphalt, and mixers, with boiler and engine for power. The contractor used a specially designed plant which could be moved a distance of 2 mi. and set up ready for operation in about three days. Two plants of less satisfactory design were in use but did not compare favorably with the two specially designed plants. The average output per plant was 600 sq. yd. per day, although under favorable working conditions 1,500 sq. yd. was attained.

The contract cost for the various types of construction used, and which includes the excavation, grading, and preparation of the subgrade follows:

Standard Section—(6-in. Foundation Course and 2-in. Wearing Surface)

	Cost per Mi.	Cost per Sq.Yd.
No side drains	$14,708	$1.68
Side drains on one side	19,698	2.20
Side drains on both sides	23,139	2.61

Drainage Section—(Sub-base 8 in. Thick, 6-in. Foundation Course, and 2-in. Wearing Surface)

	Cost per Mi.	Cost per Sq.Yd.
No side drains	$18,759	$2.26
Side drains on one side	24,639	2.75
Side drains on both sides	26,297	3.20

As previously mentioned, the contract provided for the maintenance for a period of three years from Oct. 1 of the season during which the pavement was completed. The maintenance was paid for as a separate item at 12c. per square yard, which covers labor and plant; the necessary broken stone and asphalt being paid for in addition. The specifications for maintenance follow:

To keep the pavements in satisfactory condition, the contractor shall employ three or more patrolmen experienced in bituminous road work, who shall be on duty on different parts of the work with horse and wagon continuously between March 1 and Dec. 1 of each season, and at such other times as is necessary or desirable, until the expiration of the maintenance period. It shall be the duty of the patrolmen and their assistants to keep the surfaces of the pavements smooth and true, free from "bleeding" spots, cracks, bunches, depressions, spots where disintegration or ravelling has begun, and other defects. They shall also maintain the earth shoulders of the pavements in compact and satisfactory condition, fully up to grade. All ruts or depressions on the surface of the pavement shall be immediately repaired by cutting out and replacing the wearing course and the seal coat. The seal coat shall be renewed wherever there are signs of its wearing through, disintegrating or becoming otherwise unsatisfactory. The pavements shall be repaired as many times as necessary to have them in continuously acceptable condition.

The contractor shall have, at or near the site of the work during the maintenance period, sufficient and satisfactory equipment and tools for making the necessary repairs quickly and acceptably. This equipment shall include an acceptable road roller weighting between 8 and 10 tons, suitable asphalt heaters and mixers and such other apparatus and tools as are necessary or desirable.

Asphalt cement for use in maintenance . . . shall be of acceptable and uniform quality and brand, of same or closely similar characteristics to that specified under Item 7. Before being used, it shall be sampled and tested by the Engineer. It shall be mixed and applied only when the weather is suitable. . . . Road surfaces shall be dry, swept clean and free from dust before any bituminous materials for maintenance purposes are applied thereto.

The bulk of the work of maintenance was in keeping the earth shoulders in condition, but little work was necessary to maintain the wearing surface. In the entire 3-year period, a total yardage of 4,414 sq. yd. was removed and replaced. This required the use of 32.8 tons of asphalt cement. The area of patches made was only 1.6 per cent of the total area surfaced. Slight depressions, weak places in the surface of the pavement, were repaired, applying a seal coat of asphalt and chips; where the surfaces of the stones in the wearing surface were exposed, a small amount of asphalt was applied with a brush and dusted with portland cement; the total amount of asphalt used for this purpose was 44.5 tons. The total amount used for patches and seal coat for the entire maintenance period being 77.3 tons. The contract cost for maintenance, including the crushed stone and asphalt used in repairing the surface and all other work, plant and materials required under the specifications, was $0.0458 per square yard per year. Since 1917 practically no expenditure has been made in maintaining the surfacing, the maintenance being limited to keeping the earth shoulders in condition. For this purpose, four or five men are employed from the middle of May to about Oct. 1. Each fall a road scraper, pulled by motor truck or tandem roller, has been used to remove the growth of grass and weeds from the shoulders and thereby assure transverse drainage from the road surface. No segregation of cost of this work has been made but it has amounted approximately to 1c. per square yard per year.

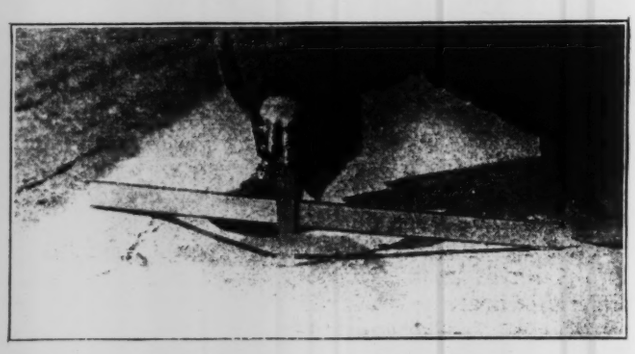


FIG. 3. THREE-INCH DEPRESSION CAUSED BY FROST ACTION ON PAVEMENT EDGE

The major part of the surfacing was done in 1914 so that the larger portion of the pavement passed from maintenance in 1917, and in that year the bulk of repairs to surfacing was made; in fact no repairs to the wearing surface were made in 1918.

Traffic over these roads is largely tourist and has grown rapidly since the completion of the highways, as the beauties of the Ashokan reservoir attract the public from miles around. Tourists passing up and down the Hudson River Valley who stop at Kingston are invariably urged to take an opportunity to see the great artificial lake in its setting of rugged mountains and to ride around it on the excellent roads. A traffic census was kept after completion of the surfacing to show the variation in different seasons. The north-side roads are on the main gateway to the Catskill Mountains and consequently there is a far greater traffic over them. The amount of traffic on Sundays is largely in excess of weekdays, as may be seen by the following tabulation which covers a 12-hr. period:

	North Side		South Side	
Kind of Vehicle	Sunday July 25, 1915	Wednesday Aug. 18, 1915	Sunday July 25, 1915	Wednesday Aug. 18, 1915
Motor-Driven:				
Cycle	50	8	8	3
Runabout	70	32	18	8
Touring car	710	391	322	122
Truck	4	8	11	3
Total motor vehicles	834	439	359	136
Horse-Drawn:				
Single	51	94	32	24
Double	13	97	8	3
Work wagons	4	27	4	5
Total horse-drawn vehicles	68	218	44	32

This census was taken during the season in which the surfacing was completed and none have been taken since, but the drive around the reservoir has grown in popularity and the assertion can safely be made that traffic is normally 25 per cent greater than the above figures indicate.

Each spring, distortions in the surface and curling

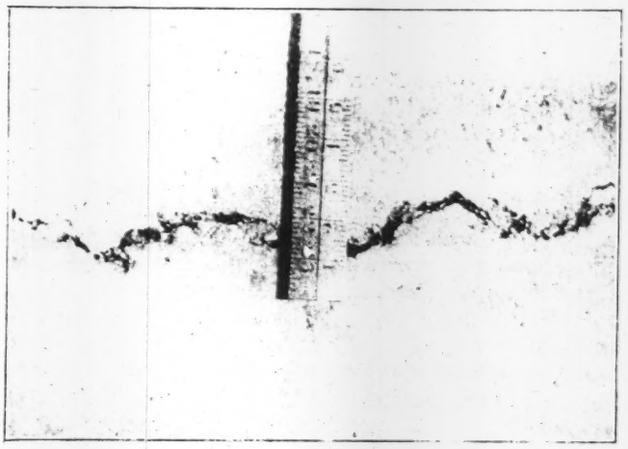


FIG. 4. TRANSVERSE CRACK THAT COMPLETELY "HEALED" AFTER FIRST WARM DAYS

up of the edges were noted, and here and there cracks in the surface, but as soon as the frost had left the ground these distortions flattened out and the cracks healed so that they could not be detected. The winter of 1916-1917 was one of uniformly low temperatures with but little snowfall, so that frost penetrated to more than the usual depth. It was noted early in the season that many culverts which were close to the subgrade had been raised by the frost, that there were many bumps and depressions, and that curling along the edges was common. These depressions and bumps varied from 1 in. to 6 in. and seemed to be more common at the junctions between cut and fill, while irregularity in surface was more common on fills. Both longitudinal and transverse cracks were not uncommon.

Perhaps the most unusual circumstance was isolated bumps which could not be accounted for until the surface was cut through, when it was found that these bumps were caused by boulders being raised by frost action. These boulders were generally below subgrade when it was prepared, although in a few cases firmly embedded boulders had been permitted to remain where drainage course was used, as it was considered better policy than to remove them and have an improperly compacted area in the subgrade. The bumps caused by displaced boulders seemed to be as common where the total thickness of the pavement was 16 in. as where only an 8-in. thickness was used, and were located where the heavy tough clay was favorable to deep frost penetration.

The surface and foundation was removed and the boulders were excavated by means of barring and wedging, but in a few cases light charges of powder were used. It was found that these boulders varied in size from a few cubic feet to over 7 cu. yd. Notwithstanding this unusual distortion, the bulk of it ironed out soon after the frost left the ground. When it is noted that only 1.6 per cent of the total area surfaced was replaced, the superior character of the pavement is demonstrated.

The winter of 1917-1918 was one of much lower temperature but with snow in quantity to provide a blanket sufficient to prevent deep frost penetration and the pavement passed through the season with practically no damage, although the distortion previously observed occurred, but to a lesser degree, and disappeared with the advent of warm weather. The oldest pavement has now been in use for six years, passing through six winter seasons, and is in excellent condition, as anyone who has had the privilege of riding around the Ashokan reservoir can testify.

The grading of these highways was done by the C. P. Bower Construction Co., of Philadelphia, Pa.; the surfacing by the State Highway Construction Co., of Beacon, N. Y., with the Continental Public Works Co., of New York City, acting as superintendent in placing the bituminous surfacing. J. Waldo Smith is chief engineer for the Board of Water Supply, under whose direction the work was done.

Special Training for Engineers in Railway Service

(Abstract of Committee Report, American Railway Engineering Association.)

THE training and education of railway engineers in the practical and economic features of their work is without method on most railways, with the result that the development of the individual is almost wholly that which comes from his being thrown upon his own resources. Systematic training and organization methods which will put the young engineer in close touch with the practical and financial relations of his work are necessary for the production of an efficient engineering staff. The above is the gist of the report of the American Railway Engineering Association's committee on economics of railway labor, an abstract of which is given below:

Where work is not well done fault may be found, but besides errors of commission, the man whose training has not been rounded out can be charged with many errors of omission. His error of omission, his failure to avail himself of opportunity, is less likely to be brought to notice, and without corrective guidance the young engineer who errs in this direction is likely to stagnate. Even the division engineer, who is the mentor of the young engineer, does not, as a rule, direct his own attention to the question of economics as fully as he should. Sometimes this neglect is chargeable to the man and his temperamental deficiencies, but generally speaking, especially on the larger systems, the engineer's sense of the importance and proper value of statistical information with respect to the economical performance of work under his direction is dwarfed, largely because of the length of time that elapses between the completion of a particular job and the time when data as to the cost of the work are available. The stores department charges out the material and the auditing department compiles the accounting.

The engineer cannot be brought to a realization of responsibility for consequences unless the man in charge is placed in a position where not only will he direct labor in the application of material, but will be in touch with all of the elements of cost as the work is in progress. Certainly, the cumbersome system of accounting with respect to maintenance-of-way and such construction of minor character as is usually delegated to a division engineer, does not make for efficiency. It is hopeless to attempt to make an economist by admonition alone. To tell a man about the cost of a job six weeks or more after it is completed will not help at all, so far as that particular work is concerned.

In the engineering department of a large railway there should be a man well fitted by practical experience

and technical training to conduct a program of development. Such a man would collect statistics, make an analysis of work accomplished and direct a campaign involving regular meetings composed of the members of the engineering force from the various divisions as well as from the general office. Papers should be prepared on subjects assigned to individuals and reports made on matters referred to committees whose membership should include beginners as well as those advanced to higher positions in the service. At such meetings, constructive criticism should be advanced as to work subject to comment, either as to methods of prosecution or economy. The exchange of views would be beneficial to the service and educational to the men.

It is hopeless for any official in charge of various projects, the completion of which continually demands his attention, to expect to singly accomplish much in educating the young engineer, even though every opportunity is seized as incidents occur. Such incidents are usually examples of errors of commission, and what is needed is to educate the men to think in a broad way. When we speak of economy it must not be summed up in the idea of parsimony, for the most important economies sometimes require the greatest outlays. The interest of engineering organizations will be served best by developing men to think wisely in large matters as well as in small.

Training the Young Engineer

In the training of young engineers the essential feature is to teach them properly to gage productive effort. Probably one of the best methods is to establish a system by which a certain percentage of the positions of supervisor or roadmaster may be filled from the engineer corps. This system affords the engineer an intimate detailed knowledge of the methods of applying material; it enables him fairly to gage the reasonable product of labor, and brings him in direct contact with the foreman and the men. This last feature is of immense value to him when he has been promoted to division engineer or some higher position. Not only will he know many of his employees, but his experience as supervisor will better enable him to get the viewpoint of the men and increase his usefulness as administrator because of his ability to maintain relations understandingly with the rank and file. By this training he will be enabled to direct working forces, to properly proportion gangs to the work, and to pass fair judgment on the efficient performance of the men under him. One of the requirements for appointment to the position of division engineer, or engineer of maintenance-of-way, should be at least two years' experience as supervisor.

Another step in the education of the young engineer should be a requirement that he have not less than one year's service in the office of the chief engineer. This will impress upon him the theories which have been acquired at school and give opportunity for applying them in practice. Serving in such capacity, he will learn more thoroughly to appreciate some of the niceties of engineering and the necessity and proper manner of furnishing information and carrying out the details of work which later on in his career he will be called upon to do. Lack of designing ability among maintenance engineers, from the division engineer down, is greatly to be deplored. Too much attention is paid to the tamping of ties and construction of sidetracks, to the exclusion of the fundamentals of engineering design. Service in the general office will in a measure cure this condition, which shortcoming is not due to faulty education but to lack of opportunity to apply in practice the things learned at school.

Summary

To summarize its ideas as to the training of the engineering forces, the committee suggests the following methods: Employ in the engineering corps men of sufficient technical training to be useful in solving the ordinary engineering problems. Carry on an educational campaign through regular and periodical meetings, the members to exchange views through papers, reports and discussion. Fill a certain percentage of the positions of supervisor of track, supervisor of bridges and buildings, supervisor of signals and inspector from the engineering corps on an equal footing with other applicants. Establish systematic rotation of service for the members of the engineering corps, to include surveying and field work, inspection, supervision of maintenance and construction and work in drafting and designing.

Launching a 10-Inch Undersea Pipe Line for Oil

By Harry Leonard
Engineer Cortez Oil Corporation, Tampico, Mexico

Most of the recent oil production of Mexico, south of Tampico, is being pumped to the Mexican Gulf coast, and there loaded on tankers. Shallow sand bars on the coast do not permit the building of loading docks, so that tankers must be loaded by undersea pipe lines extending as far as 2 mi. on the bottom of the sea. The sea end of the pipe line is connected with the tankers by means of flexible, rubber-metallic hose. The Cortez Oil Corporation of Mexico on May 2, 1919, successfully launched or pulled out to sea a 7,500-ft. line 10-in. in diameter. The work was done at their terminal station, Port Lobos, on the Mexican Gulf Coast, about 70 mi. south of Tampico.

There is much preparation to the pulling of these sea lines. It is first necessary to build on shore perpendicular to the coast, a level, straight railroad as long as the sea line. The full 7,500 ft. of pipe is connected on shore and mounted on trucks 30 ft. apart. At the sea end, the railroad curves to one side and runs about 400 ft. down the beach, this section being used to store the cars after they have cleared from the pipe. An elevated platform 4 ft. high, floored with sheet metal, over which the pipe slides, clears the cars as they approach with the pipe line. The cars are then pushed in the clear down the siding. To protect the pipe from corroding, it is painted with asphalt. Six heavy cast-iron clamps, called river clamps, weighing 850 lb. each, are bolted to the first six joints, and 100 ft. from the other end six more are bolted on to keep the line on the sea bottom after it has been pulled out. If more clamps were bolted on the line it would drag too heavily on the bottom. By means of clamps, a bridle arrangement is bolted to the end of the pipe, to which is made fast the hawser from the ship from which the hauling is done. The bridle is composed of two eye-bolts, 1¼-in. steel, 24 ft. long, and was made fast to the end of the pipe by means of two collars, bolted behind the couplings.

To keep the end of the pipe line from digging in on the bottom of the sea a wooden sled was built around its end. A bull-plug is flanged on the end, making the line air-tight, so that it almost floats in water. After leaving the track the pipe line slides out with little friction.

The tanker steamer "Herbert L. Pratt," assisted by the Texas Company tug "Central America," pulled the pipe line out to sea. The steamer approached within one-quarter of a mile of the shore and a 2-in. line from her was carried ashore by means of launches. With this 2-in. line a gasoline winch pulled the 12-in. (circumference) hawser ashore, which was made fast to the bridle at the end of the pipe line. The ship then very slowly pulled the pipe line out to sea, being guided by beacons on shore and buoys anchored in the water. The tug had a line attached to the bow of the tanker and assisted in pulling and keeping her in line. A simple system of signals, operated on shore, controlled the starting, stopping and speed of the vessels.

The time required to pull out the entire sea line was 80 min., the average speed being approximately 2 ft. per second. After the line was in place, a diver was sent down to remove the bull-plug, allowing the line to fill with water and settle on the sea bottom. The divers then flanged about 150 ft. of flexible rubber-metallic hose to the end. A buoy at the end of the hose marks its position. After connections are made on shore, line is ready to load.

The loading capacity of such a 10-in. line is approximately 4,000 bbl. per hour.

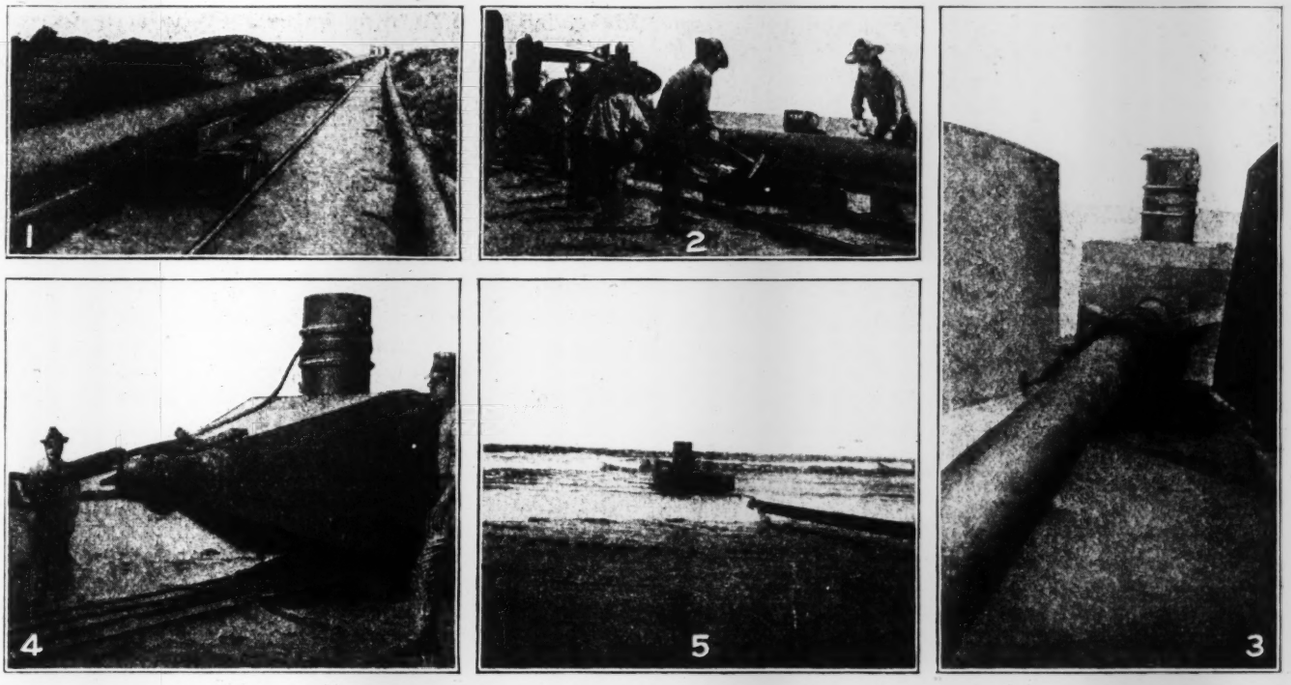


FIG. 1. PIPE LINE, TRACK AND CARS READY FOR HAULING. FIG. 2. CARS CLEARING PIPE AS THEY APPROACH PLATFORM. FIG. 3. METAL-LINED PLATFORM. FIG. 4. SLED AT LAUNCHING END OF PIPE. FIG. 5. SLED PARTIALLY SUBMERGED, SHOWING BARREL FLOAT ON TOP TO MARK END OF PIPE

Street Sweepers' Wages

It was stated by the city surveyor at the last meeting of the Exeter (England) City Council that the corporation road sweepers were now paid from 7s. 4d. to 7s. 6d. per day, according to age, for a 47-hr. week.—*The Surveyor*, London.

British Views Upon Operation of Ministry of Transport

TWO important developments in the operation of the Ministry of Transport Act are noted in recent advices from England. The first of these is the first meeting of the Roads Advisory Committee, and the second, the undertaking of classification of British roads. In the appointment of the Roads Advisory Committee and in beginning a classification of highways, the British Minister of Transport is discharging two of the important functions conferred upon him by the Ministry of Transport Act passed at the 1919 session of Parliament. Recent news dispatches are to the effect that the road classification has been actively undertaken by the Ministry of Transport in conjunction with the Roads Advisory Committee. Upon undertaking its duties in the classification of highways the Roads Advisory Committee was presented with the proposals of the Minister of Transport with regard to this classification. The following general principles have been observed by the Committee: The roads of the country are to be divided into three classes: (1) first; (2) second, and (3) all other roads. Then the classification is to be made on the basis of the relative importance of the various highways for traffic purposes. In deciding whether a road should be included in Class (1) or Class (2), the following considerations should be taken into account: Whether the road was an important route for through traffic or possessed more than local importance; the size and importance of the centers of population connected and, in particular, whether the cost of maintenance was considered to be materially affected, owing to through traffic forming a substantial percentage of the total traffic on the road.

In addition to this work outlined above for the Roads Advisory Committee, the announcement has been made

of the establishment of an Institute of Transport, with Sir Eric Geddes, Minister of Transport, as its first president. The declared object of the new Institute is "to promote and encourage a knowledge of traffic science and the art of transport in all its branches, and the means and appliances connected therewith."

After several months' operation of the Ministry of Transport Act, the British roadbuilding public, judging from editorial comment and reported discussion before technical societies, still is inclined to look askance at a Ministry predisposed toward railroad superiority in transport. Road and road transport men, still mistrusting slightly the ability of a man to administer successfully rival means of transport, do, however, admit that the bill has brought great assistance to the individual engineer and has made for greater flexibility in the administration of government funds toward road construction and maintenance. The county borough surveyor feels a definite security of tenure, now, and his financial status is being improved.

Much has been said in the English technical press recently concerning the act and its operation. The chief points in these discussions seem to be speculation as to whether the Minister himself will be able to administer fairly the business of competing means of transportation; what success the Roads Advisory Committee will have in co-operating with the Ministry of Transport in carrying out certain provisions of the act, chief among them being road classification; the classification of the roads themselves; and minor considerations.

During the early operation of the act, Sir Eric Geddes was the object of considerable editorial attention because of his fancied or real inability to administer the business of highway construction, maintenance and operation as successfully and as impartially as that of the railroads. His training and experience as a railway official made many persons suspicious that the roads were to be sacrificed to the railway interests, and the agitation which was apparent in both houses of Parliament was only partially appeased by the appointment of Brig. Gen. Sir Henry Maybury as director general of the Roads Department.

The Transportation "Czar"

Aside from the fact that Sir Eric Geddes was looked upon as a strongly pro-railway man, there was vigorous agitation against the vesting of such enormous power in the hands of one man. Even though he is admittedly a splendid organizer and is looked upon as a superman, as Minister of Transport he is given very wide powers and control over railways, canals, roads, harbors, and until the author compelled the Government to withdraw it from the bill, over the supply of electricity.

The appointment of Sir Henry Maybury as head of the Road Department, besides appeasing to a certain extent a public disposed to mistrust Sir Eric Geddes, has given to the country surveyors particularly a feeling of a certain security of tenure. Through the activity of deputation from the Institution of Municipal and County Engineers and the Institution of Municipal Engineers a clause was written into the bill requiring the approval by the Road Department of the appointment or dismissal of a road surveyor.

Inasmuch as the capacity of the Roads Committee is merely an advisory one, considerable speculation has been indulged in as to the possibility of complete co-operation between the Ministry of Transport and the Roads Advisory Committee. Speaking along those lines in discussion the utility of the Roads Committee, W. Rees Jeffreys, former Secretary of the Roads Board and Deputy Chairman of the Motor Legislation Committee, asserted that successful service on the part of the Committee would be dependent upon three factors: First, the attitude of the Minister and his department toward the Committee; second, the constitution of the Committee; and, third, the capacity of the man elected chairman of the Committee. "It would be quite possible," says Mr. Jeffreys, "for the Minister to freeze out the Committee if he so desired by the simple expedient of leaving it to its own devices. If he does, papers relating to current business will not be placed before it. Information which must be in its possession if its deliberations are to be of any value, will be withheld, or will be extracted only from the Ministry by application and after delay." Mr. Jeffreys also explained that because of diverse interests which would be represented upon the Roads Committee, it would be rather difficult to secure co-operation even among the members. Therefore, he pleaded that technical societies undertake the responsibility of doing their utmost to make the Roads Committee a success by bringing all influences to bear with the object of subverting minor and sectional interests to the broad and statesman-like consideration of road problems and road transport as a whole.

Road Classification

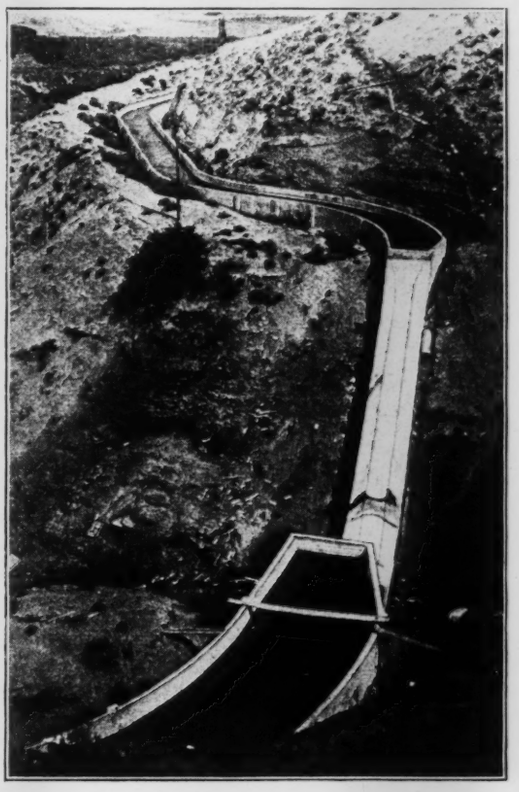
Considerable comment has also been had in the technical press as to what the system of road classification will be. The Minister is free to adopt any system of classification and distribution he may think fit. However, he is subject to one limitation—the amount of money which the treasury is willing to give him for that purpose. Just what that classification is to be is merely a matter of opinion, but it is the judgment of Mr. Jeffreys that it would be preferable to adopt a classification whereby a fair distribution is made of the maintenance grant to a large percentage of the total amount of roads. It is his statement that the Treasury will fix a figure which the first year it will be prepared to exceed, having regard to other claims on the Imperial exchequer. The Minister of Transport will therefore have to make his classification and prepare a scheme so that his liabilities will not exceed that amount.

One other consideration has been receiving some attention in the technical press and society discussions, and that concerns new construction of arterial highways. It seems to be the popular opinion that for the present little moneys will be available from the Imperial exchequer for the construction of new arterial highways, most of the money being used in maintenance grants. However, there exists an alternative in the Town Planning Act by which it is possible to lay down lines of new roads and conserve the land until such time as financial considerations permit construction. However, inasmuch as the Town Planning Act was executed through the Ministry of Health, the co-operation of technical societies is urged so that greater co-operation may be had between the Ministries of Transport and Health in facilitating road work. As a practical method of procedure, Mr. Jeffreys recommended that the public influence induce the two departments to act together so that the Ministry of Transport, working through the Ministry of Health, might give financial assistance to local authorities in joint planning schemes.

Reconstruction of the King Hill Siphon and Flumes

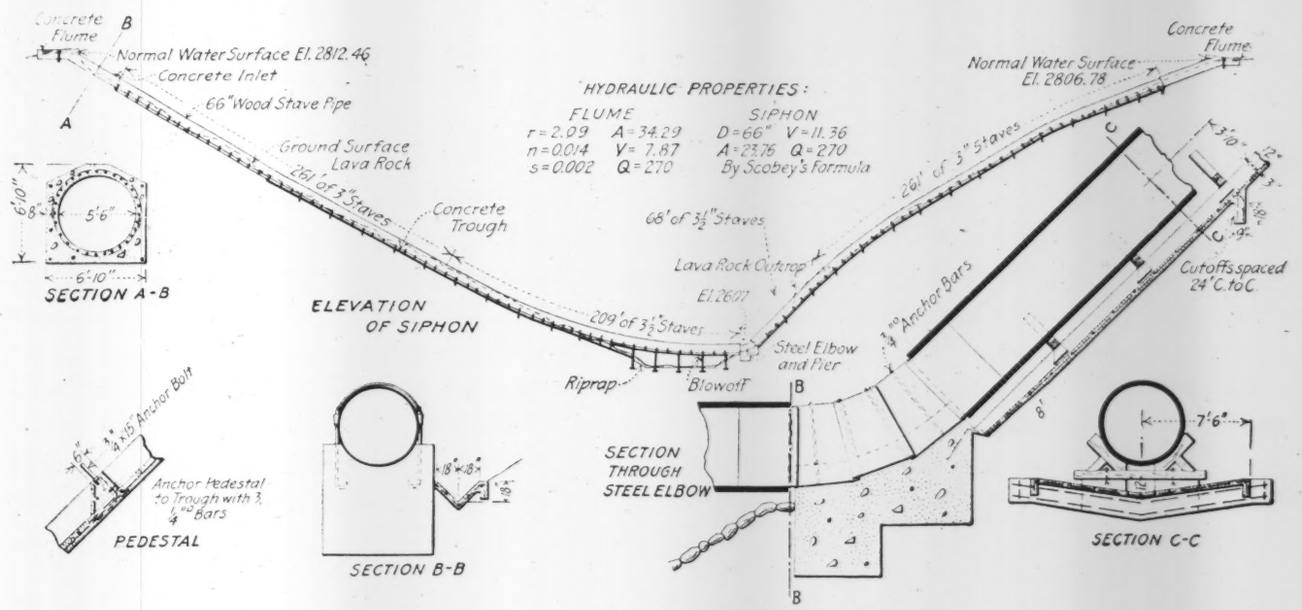
Irrigation Flumes Were Constructed as Monoliths With Gunite, With Precast Slabs and Various Combinations

SINCE ten years is the approximate life of the many timber structures on the canal system of the King Hill project of the U. S. Reclamation Service in Idaho, where replacements are now being made, an excellent opportunity exists to observe many moot questions as to design, construction and behavior in service of various types of flumes and siphons. This 17,000-acre project was started eleven years ago with a 300-sec.-ft. water right from the Malad River, the supply to be delivered to a narrow strip of land lying along the Snake River Canyon through a 52-mi. canal, 26.4 per cent of which consisted of wood-stave siphons and timber flumes, now giving away completely. The State took over the project in 1916 but, finally, the U. S. Reclamation Service agreed to spend $1,000,000 on the reconstruction. The operation and maintenance remains in the hands of the irrigation district. There are four river crossings, numerous inverted siphons and trestles across ravines, the whole course of the canal being extremely tortuous. Five miles of wood flumes are being replaced with concrete flumes and siphons. Three wood siphons are being replaced with wood. One additional wood siphon is being built to replace ¾-mi. of wood flume, thereby reducing the length by ½ mi. Two of the new siphons are of concrete, and one old wood-stave siphon has been replaced by the same material. Features in this reconstruction work are the provision for a concrete drainage apron or trough under the new wood-stave siphons, and the various types of concrete flumes. Contraction joints have about given way to thin, continuous slabs which are allowed to crack slightly at short intervals, particularly in the gunite sections. A combination precast and cast-in-place flume is being pitted against a combined gunite and cast-in-place type for cost and speed of erection, the trying conditions of long transportation, inaccessibility and varying necessities for a leak-proof flume. It will be several months before full data are available on all of these points, but enough can be given to assist irrigation engineers who had to solve in 1919 more leakage problems than ever before, because of the extremly dry season, and the insistent demand for water due to the high values for farm products.

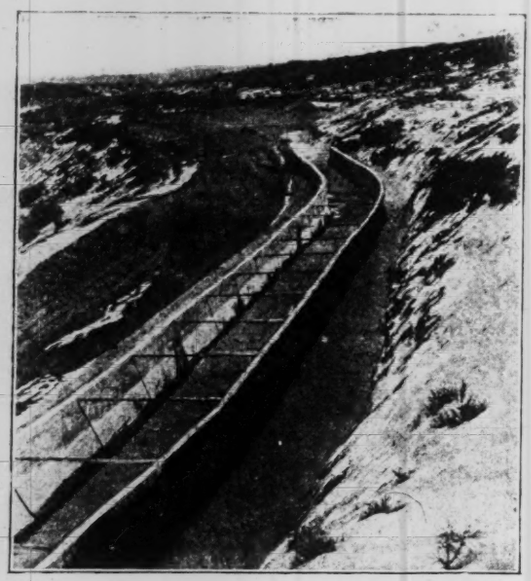


MONOLITHIC FLUME AND SIPHON
(NOTE: Seepage through horizontal joint at bottom of siphon shows a black band.)

Failures occurred in the original high timber trestles from blowing down, as well as from the rapid rotting of the timber due to the alternate wet and dry condi-



DEAR GULCH SIPHON WITH APRON FOR SEEPAGE



GUNITE TYPE WITH TIE RODS

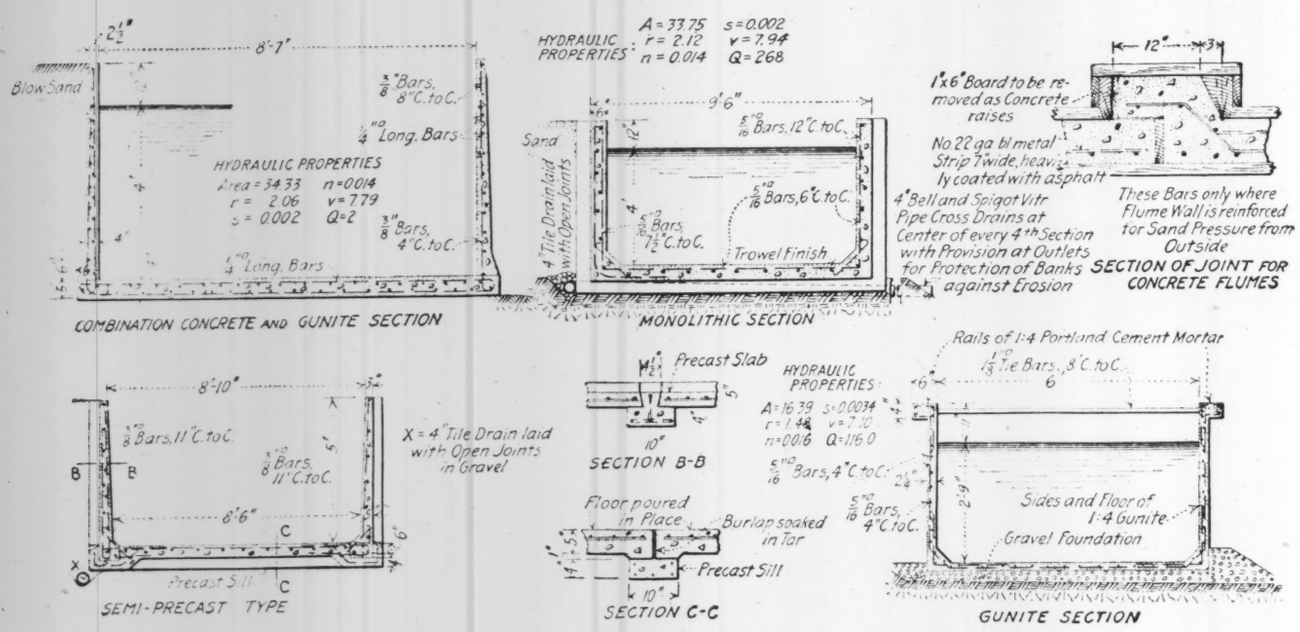
tion. Wood siphons collapsed usually from small leaks undermining the foundations. Flume timbers at the base and in trestles usually give way permitting enough sag in the flume to open large seams. With unequal loading, wind pressure usually was the final factor in the collapse. For bench flumes on the side-hill surfaces leaks undermined the whole foundation. Supporting rails and side posts rotted out due to contact with the earth. The nails pulled through this decayed wood, allowing the side of the flume to collapse.

In the Big Pilgrim wood-stave siphon, which replaces a wood siphon on a trestle 100 ft. high, and the Dear Gulch wood-stave siphon to replace a timber flume on a trestle 120 ft. high, the new construction has a thin concrete slab or apron under the pipe to carry off any leakage which may develop and cut out a stratum of sugar-like clay which is eaten away rapidly by a small stream.

Of the new concrete siphons the Little Pilgrim 6-ft. diameter concrete structure is under a 90-ft. head and has few features beyond an experience in making joints, gained during construction and subsequent operation. No expansion joints were used, only enough longitudinal steel being employed to force hair cracks at short intervals, but at the end of a day's work construction joints were kept vertical. There was no leakage of any kind, but the laitance in the horizontal joints of another siphon near the head of the canal permitted a perceptible leakage. On account of this, in subsequent work joints at the end of a day's work were placed vertically or perpendicular to the center line of the pipe and eliminated this difficulty completely, reinforcing being placed across the joint.

Typical sections of the flumes are shown in the drawings and the photographs. Of the gunite section with the tie-bars and rail there is a length of 3,300 ft. which is on a clay foundation, easily eroded, where no leakage was permissible. An examination by a representative of the *Engineering News-Record*, after use during practically two whole irrigation seasons, disclosed at a very few points moisture which evaporated as fast as it appeared. Cracks just visible were spaced at intervals of 10 in. Experience so far indicates that the tie-bars are unnecessary, but the thickness of the side walls will be increased from 2½ to 3 in. The gunite floor is rough and increases the friction so that a 10½-ft. width in a cast-in-place flume must be increased to 12½ ft. to carry the same volume in a gunite flume, the depth of each being 5 ft. 2½ in. Difficulties with the cement-gun equipment led to experiments by which it was determined that the 50-lb. pressure recommended as being sufficient at the compressor, giving 35 lb. at the nozzle, must be increased to give 50 lb. at the nozzle. A critical point in the mixture to make all of the material stick had to be discovered by trial. An excess of sand was gradually reduced until only a sufficient percentage flew off. The amount is different with different sizes of sand. So much time was consumed in learning the limitations that cost and progress figures were not considered representative.

Where there would be no difficulty if small leaks did

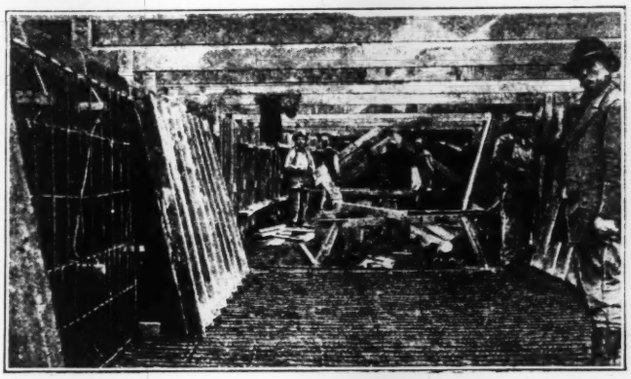

Blow Sand
HYDRAULIC PROPERTIES
Area = 34.33 n = 0.014
r = 2.06 v = 7.79
s = 0.002 Q = 2
Long. Bars
Bars, 4" C. to C.
COMBINATION CONCRETE AND GUNITE SECTION
HYDRAULIC PROPERTIES
A = 33.75 s = 0.002
r = 2.12 v = 7.94
n = 0.014 Q = 268
Sand
4" Tile Drain laid with Open Joints
Bars, 12" C. to C.
Bars, 6" C. to C.
Bars, 7½" C. to C.
Trowel Finish
MONOLITHIC SECTION
1"x6" Board to be removed as Concrete raises
No. 22 ga. bl. metal Strip 7" wide, heavily coated with asphalt
4" Bell and Spigot Vitr. Pipe Cross Drains at Center of every 4th Section with Provision at Outlets for Protection of Banks against Erosion
These Bars only where Flume Wall is reinforced for Sand Pressure from Outside
SECTION OF JOINT FOR CONCRETE FLUMES
Bars, 11" C. to C.
X = 4" Tile Drain laid with Open Joints in Gravel
Precast Sill
SEMI-PRECAST TYPE
Precast Slab
SECTION B-B
HYDRAULIC PROPERTIES
A = 16.39 s = 0.0034
r = 1.48 v = 7.16
n = 0.016 Q = 116.0
Bars, 4" C. to C.
Floor poured in Place
Burlap soaked in Tar
Precast Sill
SECTION C-C
Rails of 1:4 Portland Cement Mortar
Tie Bars, 8' C. to C.
Sides and Floor of 1:4 Gunite
Gravel Foundation
GUNITE SECTION

VARIOUS TYPES OF FLUMES USED ON KING HILL IRRIGATION PROJECT, IDAHO

occur, as on a lava foundation, a monolithic section has been constructed with bell-and-spigot joints 22 to 24 ft. apart. Two types of joint have been used. One type used in 1,800 ft. of the Four-Mile flume has a 1x6-in. board left embedded at the butt end of the spigot and an asphalt-covered metal strip placed between the sliding surfaces. A length of 2,100 ft. has the bell end coated with hot asphalt and two layers of burlap dipped in hot asphaltum. In cold weather, pockets form in the burlap which later permit leakage. The difficulty with the board is that when saturated during the irrigation season, it has a tendency to swell and break the concrete. Leaky joints may be silted up by pumping clay into the canal, but the remedy is effective only so long as water is kept in the canal. When new water is turned in former leaks persist.

In erecting forms, those on the outside are placed first and the separation blocks are secured to a rope to minimize the likelihood of their being left in place. Sections with a bell on each end were built first.

Still another type of flume is the combined concrete and gunite section, the side walls being shot into place after the floor has been placed as a monolith with a troweled surface to reduce the friction head. No tie-bar



ERECTING THE INSIDE FORMS

or contraction joints are used, steel being placed to make the fine hair cracks come about 3 ft. apart. An inside form only is erected and gunite shot against it to give a smooth interior.

So much difficulty was experienced in getting material on the ground and in moving the mixer that the semi-precast type of flume has been developed. Sides and sills are precast in a permanent plant, then hauled to place over the flume bench and erected, ready for the small amount of concrete in the monolithic floor. The slabs are 12 ft. in length and weigh 3,660 lb. Sills weigh 458 lb. A single layer of burlap soaked in tar, which is not as stiff as asphalt when cold, constitutes the joint material.

A plant for the construction of the precast parts was set up on a mesa 350 ft. above the river bank, from which gravel is raised to a crusher and screen by an inclined railway. The incline is on a 1 to 1 slope part of the way, the distance to the pit being about 1,000 ft. The slab yard is about 250 ft. in elevation above the level of the flume bench. Another inclined railway is used to lower the slabs to the flume bench, from which level the slabs and batches of concrete for the floor are transported to place over an industrial track.

Access to the Four-Mile flume during original construction was on the flume bench. Timber repair parts carry on the work expeditiously so that the flume would have had to be dragged up piece by piece from a road near the river's edge. To handle the material and to be out of commission only during the non-irrigating winter season, a road 11 mi. long, costing $38,900, has been built paralleling the flume. The slab plant is located on this road near the center of the flume work, making a 12-mi. haul to the nearest railroad station. Curves of 50-ft. radius were used, the minimum for motor trucks, also 8 per cent maximum grades against the traffic and 13 per cent with it.

The construction work of the King Hill project is under the direct supervision of Walter Ward, project manager. Most of the designs have been prepared in the Denver office of the U. S. Reclamation Service, under the direction of F. E. Weymouth, construction engineer.

Wisconsin Standardizes Highway Cost Estimates

Cost Items Listed and Classified by Contractors and Road Officials — Depreciation Charges Adopted

A UNIFORM practice in estimating costs of highway construction is being developed in Wisconsin. There has been drafted a standard bidder's estimate form which is to be used by both the state highway engineers in estimating the cost of improvements and by contractors in preparing bidding prices for construction. The form now in use is tentative and is undergoing constant revision, as experience develops faults or contributes new information, at the hands of a standing committee representing engineers, contractors, materials producers and machinery manufacturers. Trial in actual practice has been limited, but it has furnished evidence that, with alterations, particularly toward securing greater simplicity, the plan promises a high degree of success.

Items Which Enter Into Road Costs

The object in mind in preparing the forms was: (1) To list, or at least, suggest, every item which might be considered a proper cost charge in any of the operations which are likely to occur in road and bridge construction; (2) to group these items according to the class of the construction operation, and (3) to distribute properly the estimated cost between paving, grading and bridges and culverts.

Determination and classification of cost items was the chief task of the committee. While additions will doubtless be made as the committee work continues it is considered that the list is more comprehensive than those to which engineers and contractors, generally, have worked. The accepted list of items and their classification are given in Table I. Distribution of costs according to the nature of the expense as for moving equipment, for cement, for fine aggregate, etc., is clearly indicated by the tabulation. Further distribution according to the three broad divisions of road construction, namely, (1) paving; (2) grading; and (3) bridges and culverts, is provided for on the original bidders' estimate sheets.

Besides a complete schedule of cost items the cost estimate form provides for a complete distribution of expenses. This is the striking departure from common road contracting practice. For example, in the past

Item	Original Cost	Rate % per Day	No. Operating Days	Paving	Grading	Culverts and Bridges	Misc.

FIG. 1. EQUIPMENT DEPRECIATION-SHEET HEADINGS

it has been common, in the case of grading work, for a contractor to estimate the work at a certain cost per cubic yard, which included all such items as moving machinery, depreciation, upkeep, labor, teams and lost time, and to apply a certain percentage of profit on this and offer it as the bid price. With this form of cost estimate he cannot do this. He must put his moving costs under the item of "Moving Equipment," and all of the other costs in their proper places, putting under the heading "Cost of Excavation" only the cost of men and teams. Furthermore, the parts of each class of cost which are involved for paving, for grading and for bridges and culverts must be entered separately.

Two classes of costs only, overhead and depreciation, call for particular explanation. Under the item "Overhead, 12" it is indicated that certain percentages of salaries, expenses, rentals, etc., are to be charged. This means that if the job is a full year's work a full year's salary, expenses and rentals will be charged, but otherwise only the proper percentages of the yearly costs.

To determine the final item, depreciation, in Table I, a separate estimating sheet has been prepared with the column headings shown by Fig. 1. Table II gives the schedule of equipment items and the suggested per cent per mile depreciation to be charged off. In arriving at these percentages the amounts were determined on the basis of an outfit capable of building 6 mi. of 18-ft. concrete pavement per year. The amounts also include not only what is ordinarily called depreciation, but also all repairs to the machinery, interest on investment in machinery, insurance, storage, etc. For outfits which would build either a more or less mileage, certain of the percentages would change slightly, but they would agree substantially with the amounts shown.

The percentages were arrived at after considering all of the available information on the subject, but there was so little information of actual value that these can be taken only as an approximation of actual conditions.

TABLE I. ITEMS ENTERING INTO COST OF HIGHWAY CONSTRUCTION TO BE CONSIDERED IN ESTIMATING BUILDING PRICES

(1) *Moving Equipment*
Hauling from shed to cars
Loading
Freight charges
Cost of unloading
Moving to job
Lost time of equipment
Erection of camp including water supply
Transporting teams or trucks
Return of above

(2) *Cost of Rental of R.R. Siding*

(3) *Cement*, Cost per Bbl., f.o.b. cars at
No. of barrels
Unloading and storing
Hauling and covering
Fire insurance on cement and empty sacks
Sack loss 2% to 5%
Freight return of empty sacks
Demurrage

(4) *Fine Aggregate*
No. of cubic yards, including waste
Average price per cu.yd., f.o.b. pit or quarry
Freight and demurrage
Labor —unloading
Hauling to job
(Labor and horses)
Spotting on job
Rehandling from stock pile

(5) *Coarse Aggregate*
No. of cubic yards, including waste
Average price per cu.yd. f.o.b. pit or quarry
Freight and demurrage
Labor—unloading
Hauling to job
(Labor and horses)
Spotting on job
Rehandling from stock pile

(6) *Surfacing*
Rolling subgrade
Joint material delivered on the job
Labor mixing and placing concrete (including engineer, firemen, form setters, fine graders, wheelers, shovelers, cement men, puddlers, baling and sorting sacks, curing, covering and uncovering, finishers, water boy, watchmen, barricade and lights)
Foreman days @
men days @
men days @
men days @
men days @

Pumping and Water Supply
(Labor, connecting pipe, setting pump, operator, fuel, disconnecting pipe and drilling well)
Gasoline, coal, oil, etc.
Hiring, shipping in men and loss in running camp
Purchase of hardware, lumber, boots, etc.
Rent of water, buildings, warehouse, grounds, etc.
Building cross-overs

(7) *Breaking and Moving Dirt and Rock*
Staking
Keeping road open to travel
Clearing
Grubbing
Excavating earth, light,
Men and teams only
Excavating earth, heavy
Men and teams only
Excavating rock, loose
Men and teams, only
Excavating rock, solid
Men and teams only
Dynamite
Sloping
Trimming
Shoulders
Ditching
Moving, enter under No. 1
Equipment, etc., enter under No. 1

(8) *Culverts and Bridges*
No. cu.yd. in job
Moving equipment enter under No. 1
Labor enter under No. 6
Material enter under Nos. 3, 4 and 5
Labor excavating, removing of old structures: building forms, removing forms, placing concrete
Detours or temporary bridges
Piling
Cofferdams
Expansion joints
Waterproofing
Drains
Steel
Lumber

(9) *Guard Rails*
Posts
Lumber
Paint
Hardware
Creosote
Labor
Hauling

(10) *Unforeseen Difficulties*
Delays due to R.R. embargoes, strikes at pit or jobs, material plant breakdown, breakdown of machinery, failure of water supply, bad weather, pipe line breaks and freezing,

(11) *Compensation and Public Liability Insurances* (labor only)

(12) *Overhead*
Per cent of manager's yearly salary
Per cent of yearly salary of stenographer and clerk
Per cent of yearly salary of material man and timekeeper
Per cent of yearly expense of manager
Auto miles at 12c.
(Railroad fare, hotel, meals)
Bidding costs, conventions, associations
Per cent of yearly office rent
Per cent of yearly office telephone and telegrams
Per cent of office supplies, miscel.
Corporation insurance
Interest on borrowed money

(13) *Bond Cost* (personal or surety)

(14) *Total Net Cost of Job*

(15) *Profit* for each Class of Work, as paving, grading, etc.

(16) *Depreciation* on Equipment as listed in Table II.

TABLE II. ESTIMATED DEPRECIATION OF MACHINERY AND EQUIPMENT PER CENT PER MILE OF ROAD

	Per Cent
Road rollers	2–4
Mixers	6
Finishing machine	7
Sectional storage bins (erecting cost No. 1)	7
Special storage bins	
Material and labor (charge full cost)	
Clamshell crane	4
Stiffleg derrick (erecting cost at No. 1)	4
2 pumps	6
Pipe line — miles (include laying cost at No. 6)	6
Side forms — ft. (steel), material only	12
Side form — ft. (wood), material only	27
Iron stakes, material only	15
Ford cars (1 camp car, including operating costs)	16
One service car (including operating costs)	16
Canvas	10
Hose	16
Wheelbarrows	10
Locomotive	6
Cars	6
Track	2
Batch boxes	10
Concrete roller	20
Strike-off board (charge full cost to job)	
Mixer loaders (belt conveyer)	12
Wagon loaders (erecting cost at No. 1)	7
Camp equipment (stoves, bedding, bunks, camp on trucks, etc.)	8
Small tools (charge full cost to job)	16
Wagons (plain)	1
Wagons (dump)	1
Trucks	1
Wheel-scrapers	1
Fresnoes	1
Slushers	1
Graders (heavy)	1
Graders (light)	1
Plows	
Rooter	
Medium	
Light	
Heavy	
Steam-shovel, including fuel, oil, etc.	
Elevating grader	1
Maney wheel-scrapers	1
Steam drill	1
Compressor	1
Tractors	

Pressure of Concrete on Forms Measured in Tests

Diaphragm Cell Placed in Bottom and Sides of Test Boxes and Actual Forms—Formula for Pressure Devised

By E. B. Smith
Senior Assistant Testing Engineer, U. S. Bureau of Public Roads, Washington, D. C.

Abstract of a paper presented to the Convention of the American Concrete Institute, Chicago, Feb. 15-18, 1920.

THE tests presented in this paper were carried out by W. E. Rosengarten in the laboratory of the research section of the Bureau of Public Roads located at the Arlington Experimental Farm, near Washington. The field tests were made during the construction of the walls and columns of a reinforced-concrete building.

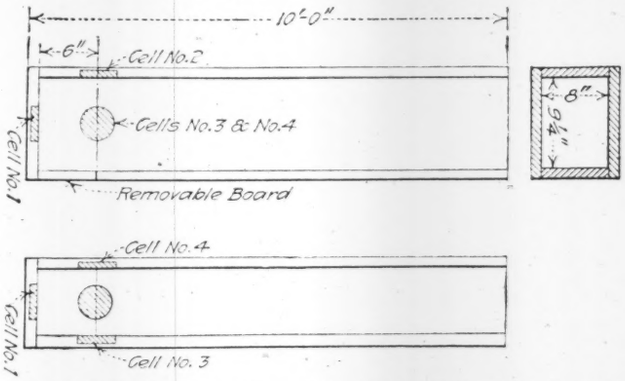


FIG. 1. FORM USED IN TESTS OF PRESSURE OF CONCRETE

The apparatus used to measure the concrete pressures were cells and gages similar to those described in the *Proceedings* of the American Society for Testing Materials, 1917, p. 641, and used for the past few years by this laboratory in measuring earth pressures behind retaining walls and under fills. The instrument, devised by A. T. Goldbeck, was described in *Engineering News-Record*.. It consists essentially of an air-tight metal cell having a circular weighing face 10 sq.in. in area. The concrete pressures against the face of the cell are balanced by admitting compressed air to the inside of the cell. When the pressures are balanced an electrical contact is broken which extinguishes a light and indicates that the pressures shown on the gage connected with the air pipes is equal to the pressure of the concrete. Tests on these cells have shown them to be accurate considerably beyond that necessary for these tests, and that the movement of the face is less than one ten-thousandth of an inch to break contact, thus making the cell admirably suited for tests on pressures exerted by granular materials, soils, mud and concrete.

Several other experimenters have attempted to obtain such data, but some have been greatly handicapped by not having a suitable apparatus for determining the concrete pressures. Any scheme for determining the pressure values that depends upon a movement of the concrete at the time of making the readings is evidently not reliable. The values desired are the static pressures of concrete against an immovable surface, and not the pressures necessary to stop a moving mass of concrete, nor to start a movement of the mass. And any scheme requiring first the disturbance or movement of the mass before making the pressure readings is also undesirable.

The arrangement of the pressure cells and the concrete form used during the laboratory tests is shown in Figs. 1 and 2. The form was built of 2-in. planks giving an inside horizontal cross-section of 7.8 in. by 9.4 in., and a height of 10 ft. Four cells were placed in the form, with the weighing face flush with the inside of the forms. Cell 1 was placed in the center of the base and indicated the vertical pressure. Cell 2 was set in the center of the rear wall of the form. Cells 3 and 4 were placed in the center of the right and left side walls of the forms respectively. The centers of these cells for obtaining the lateral presure were all 6 in. above the base. Air control pipes leading from all cells were arranged in order, with connections and nipples conveniently located for taking the readings on the four cells very quickly.

FIG. 3. PRESSURE GAGES APPLIED TO COLUMN FORM IN BUILDING

The materials for the concrete used in the tests were carefully weighed and mixed by hand. Immediately upon completing the mixing the concrete was shoveled into buckets and dumped into the top of the forms. The mixing floor and the wood forms were well wetted before the test was begun. The concrete was tamped on top by the use of a long stick having a 2 x 6 in. foot on the lower end. The outside of the forms were also vibrated by striking with a heavy hammer. The height to which the concrete stood in the column form was then measured, and the pressures on the bottom and three side cells were immediately read and recorded. The batches were varied in size so that when a new batch was added each 10 min. the head of concrete

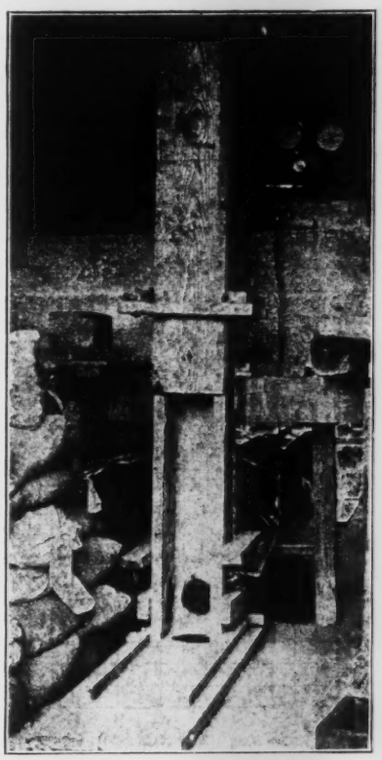


FIG. 2. VIEW OF TEST FORM IN LABORATORY

in the form would increase at the rate desired. Readings were taken on the pressure cells immediately after placing the concrete, and again about 5 min. later or shortly before placing the next batch of concrete.

The air and the mixing water temperatures were recorded each day tests were run. Slump tests of the concrete were made to determine the consistency used in each test; and are recorded as inches slump, or where very wet as inches diameter of the mass. Fresh batches of concrete were added every 10 minutes until after the pressures on the cells had passed a maximum and indicated a decided decrease in pressure. The tabulated data and results of a typical one of these laboratory tests are shown in Fig. 4.

Several field tests were run in addition to the laboratory tests described above during the construction of a reinforced-concrete building at the Arlington Farm. The pressure cells were inserted in the wall and column forms as shown in Fig. 3 and pressure readings taken at the time the concrete was being poured. The concrete was machine mixed, raised in an elevator and directed into the forms through a system of chutes. It was then spaded or tamped with a stick having a small blade on the end. The concrete was a 1:2:4 mix, river gravel being used for the coarse aggregate, and the consistency rather sloppy, flowing readily around the steel reinforcing. The results from these field tests conform favorably with those obtained from the laboratory; typical results are shown in Fig. 5.

The results shown by these experiments indicate that the fundamental pressure of concrete against the form is about 1 lb. per square inch for the first one foot of head. However, this is by no means all that should be said. A study of the results reported by others, and those obtained from this series of tests show that the following factors have an influence upon the pressure, namely: (1) rate of filling the forms; (2) cross-sectional area of the forms; (3) consistency of the concrete; (4) amount of cement in the concrete; (5) temperature of the concrete and the time of set of the cement; and (6) character of the fine and the coarse aggregate.

Sufficient data is not yet available to make final state-

1:2¼:3¾ Mix. Grav. Agg.

Curves	Pouring Rate, Ft./Hr.	Time to Max. Press. Min. Lat.	Time to Max. Press. Min. Vert.	Air Temperature	Total No. Batches
A	1.5	90	90	74° F.	9
B	2.7	61	78	80° F	10
C	3.3	44	49		14

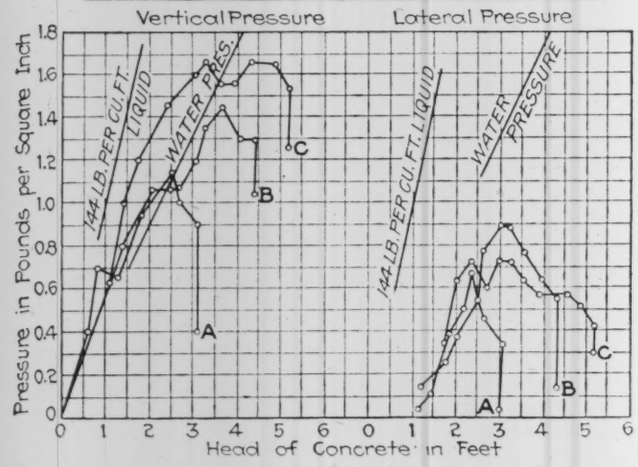


FIG. 5. CURVES OF PRESSURE OF 1:2¼:3¾ CONCRETE IN FIELD TESTS

ments as to the law by which each of these factors influence the pressure of the concrete against the form. The results do show that the initial pressure under small heads is equal to the hydrostatic pressure of a liquid having the approximate density or weight of the concrete; that is, approximately one pound per sq. in., or 144 lb. per square foot for the first foot head. As pouring is continued this pressure, however, soon falls below the straight line hydrostatic pressure and the amount of this deviation depends upon one or more of the factors mentioned above.

It is important to notice that the results prove that if filling is continued indefinitely the lateral pressures near the base of the form finally reach a maximum value and then decrease gradually to zero, regardless of the fact that fresh concrete is continually added above. The vertical pressures are in all cases greater than the lateral pressures—they decrease in value after a maximum has been attained, but not to zero. The total weight of the concrete mass in ordinary construction is not supported entirely upon the bottom of the form, but because of the roughness and friction against the sides the planking takes part of the weight or vertical pressure. Of course, for wide and shallow masses of concrete such as floor slabs the vertical pressure is equal to the weight of the concrete.

A summary of the data at hand seems to lead to the following conclusions regarding the effect of the various influencing factors:

1. The maximum pressure exerted upon the forms increases as the rate of filling increases. At a slow rate of about one foot per hour the pressure is approximately 1 lb. per square inch but as the rate increases beyond this value the pressure increases approximately as the 0.3 power of the rate.

2. Field tests which are made in places where the distance between the form walls differed indicate that the maximum pressures obtained increase slightly with the mass of the concrete when the consistency is wet and sloppy. This conclusion probably does not hold in the case of dry mixes. Reinforcing just inside the form tends to slightly decrease the pressures, but probably this effect would be neglected in determining the final pressures for use in design.

3. The results show in general that the maximum pressure was increased as the consistency of the concrete was made drier within the limit of workability. This is probably different from what might be expected but the tests show it to be the case. It is probably due to the fact that under the usual conditions of placing dry concrete, it requires more tamping, which, because of its dryness, seems to develop a permanent wedging action between the particles. In the case of wet or sloppy concrete this wedging action does not exist, as we have approximately a static fluid pressure. For low heads the dry concrete (when tamped as usual) will give the greater lateral pressure, but for heads of four feet or more and within the time when initial set becomes an influencing factor the sloppy mixtures give the greater pressure. The average increase of pressure due to the effect of dry mixtures seems to be 0.3 lb. per square inch for each inch decrease in the standard slump test less than a 5-in. slump.

4. The richness of the mix also affects the maximum pressures obtained. The richer the mix the greater the maximum pressure. The average increase being

0.12 lb. per square inch for each per cent increase in the ratio of the cement to the aggregate beyond 12%.

5. A decrease in the temperature of the concrete retards the set of the cement, and it is natural to suppose that this is the limiting factor in the maximum pressure obtained, since the pressure increases with the head until the cement takes a sufficient set to begin to support the overlying concrete. Therefore, as the temperature is reduced and the time of the set of the cement is increased, the height of fill may be increased and thus produce or make possible a higher total pressure. Since the cement begins to set and stiffen in about thirty minutes, the maximum pressure is attained under whatever head of concrete may exist at this time. The value for H, the head of concrete, to be used in the formula given below should not be greater than one-half the rate of fill; except where agitation is vigorous and continuous in a sloppy mix, then, this ratio may be taken up to three-fourths.

Formula for Pressures

An empirical formula giving the lateral pressures required for use in the design or the investigation of the strength of concrete forms, and taking into account the above numerical factors, is

$$P = H^{0.2}RO^{0.3} + 0.12C - 0.3S$$

P being the resultant lateral pressure in pounds per sq.in.; R, the rate of fill in feet per hour; H, the head of concrete fill; C, the per cent by volume of cement to the combined fine and coarse aggregate; and S, the consistency in inches of slump.

The vertical pressure is obtained by adding $0.25H$ to the value of P as found above. Except when the inside distance between the vertical sides of the form is greater than one-half the depth of fill, then the value should be taken as equal to the weight of the concrete.

In the practical application of this formula, as with all formulas there is abundant opportunity for the exercise of common sense and good judgment. The formula will give pressures somewhat higher than exact values. It shows the effect of continuous and vigorous agitation of the concrete mass only as this is introduced through good judgment in selecting the value for the head of concrete, H. For usual conditions H may be taken as not greater than one-half of R. For ordinary cement in cold weather, or when continuously and well agitated, H may be three-fourths of R, when the filling is continuous beyond one hour. A second pouring on top of concrete that has been in place for 45 min. or more does not add to the pressures already existing at the bottom of the fill.

The values for C may be taken as the next higher whole number in the per cent of cement by volume, as the required accuracy does not justify fractional per cents. Values for S may also be taken as whole numbers, since the slump test is not accurate closer than 1 in.

The value of P obtained by the formula is the lateral pressure against the form at the lowest point of the fill. Since the pressures are not uniform from top to bottom, but very approximately as the ordinates of a parabola, the center of pressure or point of resultant pressure may be taken at 0.6 of the height of fill, H, from the top.

The following examples may serve to show the use of the above formula

1:1½:3 Mix Gravel Agg

Curves	Pouring Rate, Ft/Hr	Time to Max Press. Min. Lat.	Time to Max Press. Min. Vert.	Air Temperature	Total No Batches	Consistency
A	1.8	75	75	62°F.	11	15/16" Diam 3" Slump
B	7.6	38	38	64°F	7	14" Diam 8½" Slump
C	1.8	106	106	70°F.	15	
D	3.8	66	66	68°F	11	12" Diam
E	7.5	60	60	64°F	8	13" Diam

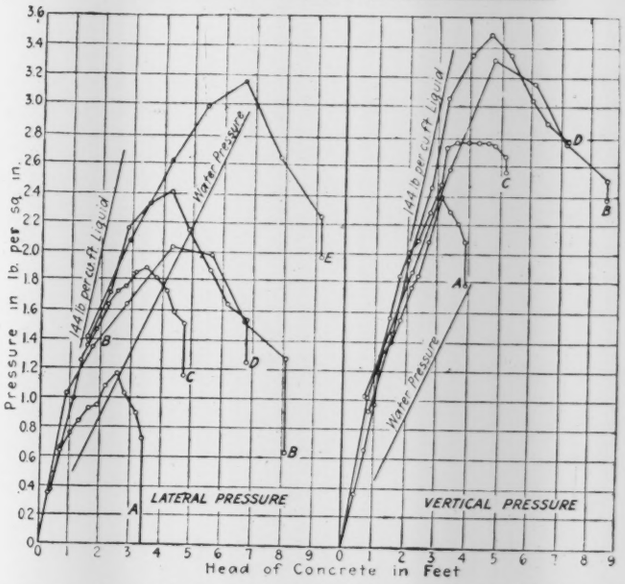


FIG. 4. CURVES OF PRESSURE OF 1:1½:3 CONCRETE IN LABORATORY TESTS

Example I. For reinforced mass concrete. Mix to be 1:3:5; consistency rather sloppy, or 9-in. slump; the rate of fill R to be 8 ft. per hour. The total height of concrete filled within one hour, 7 ft. Since this concrete is placed from a chute in a large form, and men are continually walking around in it, the value to be chosen for H is 6, or three-fourths of R. Then, substituting in the formula:

$$P = 6^{0.2}8^{0.3} + (0.12 \times 13) - (0.3 \times 9)$$

$P = 1.53$ *lb. per square inch*

The vertical pressure = 3 *lbs. per sq.in.*

Example II. For reinforced-concrete column. Mix to be 1:2:4; consistency 8-in. slump; rate of fill to be 24 ft. per hour. Total height of column and final fill 11 ft, made in one pouring; since this is done in less than thirty minutes the value for H is 11. Substituting

$$P = 11^{0.2}24^{0.3} + (0.12 \times 17) - (0.3 \times 8)$$

$P = 3.83$ *lb. per square inch*

Vertical pressure $= P + 0.25H = 6.58$ *lb. per square inch.*

Example III. For thin curtain walls and reinforced bulkheads. Mortar mix 1:5; consistency 8-in. slump; rate of fill 20 ft. per hour. Total height of fill in one pouring, 14 ft.; the value to be selected for H should be 10, since that is the height of fill at 30 minutes when the effect of stiffening and set begins. Substituting:

$$P = 10^{0.2}20^{0.3} + (0.12 \times 20) - (0.3 \times 8)$$

$P = 3.89$ *lb. per sq.in.*

Vertical pressure $= P + 0.25H = 6.39$ *lb. per sq.in.*

Example IV. For dry mix, mass concrete. Mix to be 1:3:6; consistency, 3-in. slump; rate of fill, 6 ft. per hour; distance between sides of form, 3 ft; total height of fill within 30 minutes, 4 ft. Then,

$$P = 4^{0.2}6^{0.3} + (0.12 \times 11) - (0.3 \times 3)$$

$P = 2.68$ *lb. per sq.in.*

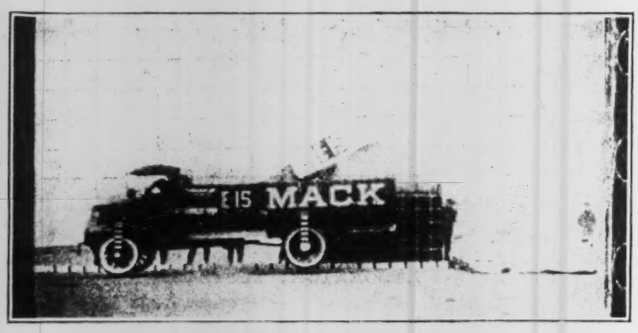
Vertical pressure = 4 *lb. per sq.in.*

Tests Reveal Relative Values of Pneumatic and Solid Tires

By Alfred F. Masury
Chief Engineer, International Motor Co.

While engineers are agreed that pneumatic tires reduce road impact and resultant shock to the chassis and that the effect of light unsprung weight is similar, it was not until recently that actual tests were conducted to give physical proof of these assumptions. Such tests have been made by the International Motor Co., employing a novel type of motion picture for the close study of the motion of the parts while negotiating obstructions and striking the earth.

In these tests results were recorded photographically by a new type of motion picture camera making 160 exposures per second and which when projected, "slowed down" the action to one-tenth the normal speed. The



THREE-TON TRUCK ON THE REBOUND, SHOWING LOAD BOUNCING IN BODY

results which have recently been announced were so convincing that one tire manufacturer has already begun similar tests to compare the impact effect of pneumatic and solid tire equipment on motor trucks.

The purpose of the tests was to subject various types and sizes to shocks in excess of anything likely to be encountered in actual service and to make careful observations of the effect of road impact on spring and tire equipment as well as the effect of unsprung weight upon road impact. The trucks were run at speeds from 15 to 18 mi. per hour along a straight-away and over an incline rising 1½ ft. in a distance of 6 ft. In each case the speed of the truck was determined by having it make a flying start, and timing it with a stop watch over a measured course of 100 ft. from the base of the incline.

The time of flight through the air of each axle, the time of deflection of each spring and tire, the time of rebound of each spring and tire, and similar details of the tests were determined by several means to check the data for accuracy. An Eastman kodak timer was used to show seconds on the motion picture films that were taken to record the tests. An ordinary hand sewing machine with a white card fitted on the plunger was set on the table in back of the incline, and so adjusted that the card rose and fell three times with each revolution of the crank. This was operated by a man with a stop watch who turned the crank three times per second. A phonograph motor and turntable mounted in a box was placed on the stone buttress at the near side of the incline, the turntable carrying a cardboard cylinder marked off in four sections in black and white, the first, solid black, the second white on top and black at the bottom, the third, solid white, and the fourth black on top and white at the bottom. The governor of the motor was set for 60 r.p.m., so that the pattern on the cylinder showed quarter-seconds. All of these instruments were put into action simultaneously with the running of each truck over the incline and recorded together both by still and motion pictures.

The horizontal distance which the trucks jumped was measured by a curbing along the back of the runway marked off in feet. A large blackboard near the incline, marked off in feet both vertically and horizontally, showed the vertical rise of the different portions of the truck. The rise of the tires, one spoke on each wheel and the hub-caps were pained white, as a guide to revolutions made. A strip of sheet metal, extending down from the lip of the fender, was marked off in black and white at 3-in. intervals to show the rise and fall of the hub. The tire deflection was measured by means of the white rims and the white spoke enabled the revolutions of the wheel in the air to be counted.

Motion Pictures Permit Analysis

In addition to numerous still pictures with different forms of cameras, motion pictures of the two kinds were taken to permit analysis in the laboratory. One of these was the standard motion picture machine taking 16 exposures per second and the other a novograph, a new type of camera which takes pictures nine times as fast as the normal projector. Each jump was photographed simultaneously by both cameras and a composite film made up in which each jump was shown first at normal speed and then "slowed down" by the novograph. This film was then projected at normal speed, whereby each jump was shown twice, the first time, as it actually appeared and then at one-ninth normal speed, which allowed the human eye to trace the intricate movements of the different parts as the flight through the air was made. These films were studied both running and still, accurate measurements and calculations made and conclusions definitely arrived at.

The trucks tested comprised the following: One standard Mack AB 1½-tonner having pneumatic tires on front and solids on the rear, and an experimental gear-driven axle; an AB 2-tonner with pneumatic tires all around and the same type of rear axle; an experimental 3-ton truck; a 3½-ton chain-driven AC model; and a 5½-ton AC with an experimental chain drive. These were numbered as follows: E-8, E-17, E-15, E-22, and E-18.

The conclusions drawn from the tests showed that the impact of a truck striking the ground after bounding over an obstruction is increased approximately as the square of the speed and as the weight; but inversely as the resiliency of the springs and tires.

It will be seen that two of the trucks were of very similar design, one having solid rear tires and the other pneumatics all around. A comparison of the results shown by these two gives startling conclusions. The one with solid rear tires weighed 9,330 lb. and the one on pneumatic tires 10,200 lb. The lighter one had 6,400 lb. on the rear tres and the other 7,100 lb. The former had 1,000 lb. spring deflection per inch and the latter 1,183 lb. Going over the jump at $17\frac{1}{16}$ mi. per hour this lighter truck jumped 17 ft. 3 in., the other 17 ft. 7 in. Thus they jumped about the same distance at the

same speed. Their weight was similar and they had about the same proportion of sprung to unsprung weight. Their springs were also similar, and yet when the forces set up by the shock of landing were figured an astonishing difference was found which could only be accounted for by the difference in tire deflection between the solid and pneumatic tires. The solid-tired truck showed a spring deflection 3¼ in. and a tire deflection of 1 in. The pneumatic-tired truck showed a 5½-in. spring deflection and 4½ in. of tire deflection, all of these figures being taken on the rear wheels only. The force with which the unsprung portions of the solid-tired truck struck the ground was 14,336 lb. as against but 4,624 lb. on the pneumatic-tired unit. Those on the sprung portions of the solid-tired truck were 13,014 as against 9,282 on the pneumatic-tired one.

From this we see that whereas the pneumatic-tired truck had 620 lb. more weight on the rear axle, it went over the same jump at the same speed as the solid-tired one, but owing to the greater deflection of the pneumatic tires, 450 per cent greater than the solids, it hit the ground less than two-thirds as hard. In other words its unsprung impact on the ground was 9,712 lb. or 68 per cent less than that of the solid-tired truck. This was not directly due entirely to tire deflection, of course, for we have seen that there was greater spring deflection, but this is all the more remarkable, for we have that these springs were 183 lb. each, or 366 lb. for both rear springs, stiffer than those of the solid-tired truck. The only way it can be accounted for is that the deflection of the pneumatic tires served so to lessen the rebound of the unsprung portion of the truck as to give the effect of lighter unsprung weight and consequently to lessen the resistance of the axle to the deflection of the spring. This represents the effect of impact on the road. The forces acting through the sprung portions of the truck represent the reaction of the blow on the vehicle itself. The sprung force was 3,732 lb. or 29 per cent less on the pneumatic-tired truck than on the solid-tired one, which is natural, considering that less impact of the unsprung portions of the road would produce less reactive thrust on the frame.

The pneumatic therefore saved the road two-thirds the "grief" and the vehicle itself one-fourth. Following the thought to its logical conclusion, it would seem obvious that a 7½-ton truck on pneumatic tires would do less damage to the road than a 5-tonner on solid tires, operating over the same route and at the same speeds.

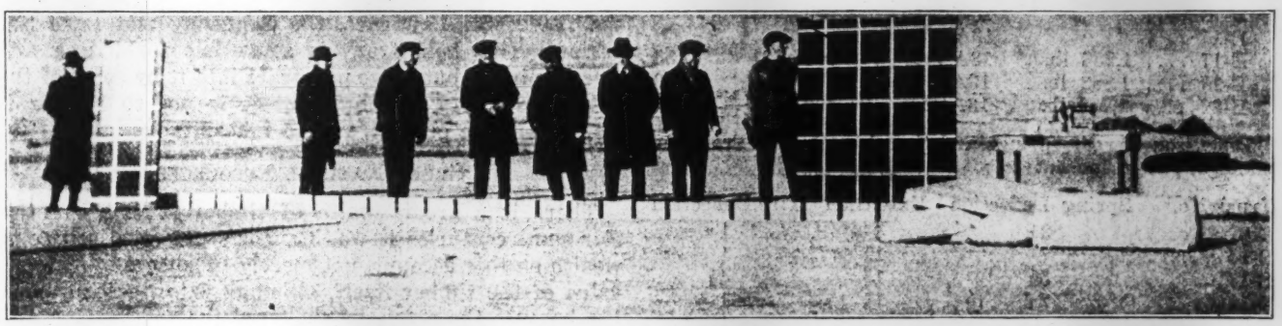
The summarized results of the tests as compiled by the Mack engineers are as follows:

Comparison of Distances Jumped by Each—Trucks and Miles Per Hour at Which the Trucks Took-Off

	Miles Per Hour			Distance in Feet		
	1st Jump	2nd Jump	3rd Jump	1st Jump	2nd Jump	3rd Jump
E-8 ..	16.8	13.6	17.1	14′ 6″	15′ 0″	17′ 3″
E-15 ..	13.6	15.1	9.6	11 1	15 7	7 0
E-17 ..	11.3	16.8	17.1	6 6½	14 7	17 1
E-18 ..	15.1			9 2		
E-22 ..	13.6	14.3		13 5	15 0	

The following is a table of the weights on the front and rear of the various trucks:

Truck No.	Front	Rear	Total
E-8	3,200	6,480	9,680
E-15	3,453	8,417	11,870
E-17	3,100	7,100	10,200
E-18	5,480	13,500	18,980
E-22	5,850	14,650	20,500



GENERAL LAYOUT SHOWING TAKE-OFF TURNING AND MEASURING DEVICES, ETC.

The weights on the rears are as follows:

Truck No.	Unsprung	Sprung
E-8	1,716	4,764
E-15	2,140	6,277
E-17	1,754	5,346
E-18	3,136	10,364
E-22	2,446	12,204

The energy exerted by a falling body is equal to the energy required to raise it to the height from which it fell. If the vertical velocity and weight are known the energy equals the weight times the vertical velocity squared, divided by twice the acceleration due to gravity, or:

$$E = \frac{WV^2}{2G} = \frac{WV^2}{64.32}$$

W = Weight in lbs.
V = Vertical velocity in ft. per sec.

In the case of a motor truck driven over an upward inclined plane, the vertical velocity can be obtained from the speed of the truck and the angle of the incline, or:

$$V = \frac{S \times 88T}{60} = \frac{22ST}{15}$$

S = Speed in miles per hr.
T = Tangent of angle or incline.

The average force of a blow equals the energy of a moving body in foot-pounds divided by the distance of feet required to stop it, plus the weight of the body, or:

$$F = \frac{E}{D} + W$$

D = Distance to stop in ft.

Combining 1, 2 and 3

$$F = \frac{W\left(\frac{22ST}{15}\right)^2}{64.32D} + W$$

This formula can be applied to the unsprung weight of a motor truck by taking the deflection in the tires and ground, add to the sprung weight by taking the spring and tire deflection.

Applying this formula to the trucks jumping, we get the following results:

Truck No.	Speed	V^2	Rear Unsprung	Rear Sprung	Tire Deflection	Spring & Tire Deflection
E- 8	17.1	29.4	1,716	4,764	0.083	0.354
E-15	15.1	30.6	2,040	6,277	0.083	0.666
E-17	17.1	39.4	1,754	5,346	0.375	0.833
E-18	15.1	30.6	3,136	10,364	0.083	0.264
E-22	14.3	27.4	2,446	12,204	0.083	

	Unsprung Force	Sprung Force	Sprung Force From Spring Deflection
E-8	14,336	13,014	3,250
E-15	13,890	10,757	
E-17	4,624	9,286	6,800
E-18	21,076	29,004	4,100
E-22	14,866		

The deflection per inch of each rear spring:

Truck No.	Measured Deflection Per Inch	Part No.	Calculated
E- 8		13AB226	3,250 in 3¼ " 1,000
E-15		13AD25	
E-17	1,233 lb.	13AB227	3,700 in 3¼ " 1,183
E-18	1,883 lb.	13AC29D	6,400 in 3 3/16" 2,000
E-22	1,700 lb.	13AC29C	6,400 in 3¾ " 1,750

Deflection of rear springs and tires is measured from the photographs in inches:

Truck No.	Spring Deflection	Extension	Tire Deflection
E-8	3¼	4	1
E-15	7	1¼	1
E-17	5½	1⅞	4½
E-18	2 3/16	1⅝	1
E-22			1

The force of the blow on the ground from the unsprung and sprung weight can be figured by this formula. These forces should not be added together, for they do not occur at the same time.

Ethics Case Decided by Institute of Consulting Engineers

Case No. 13 in professional practice and ethics concerning the retention of a consulting engineer as expert witness against his client has been decided by the American Institute of Consulting Engineers. The case is as follows:

Statement: A consulting engineer has a client, A, for whom he is making certain important investigations, pending which an attorney, B, asks the engineer to accept a retainer as expert witness in a suit at law against A. The matter on which the engineer's testimony is wanted by B is totally unrelated to the matter being investigated for A.

Questions: (1) Is it proper for the engineer to accept the retainer from B?

(2) If the engineer may properly accept the retainer from B, should A be advised of the acceptance of the retainer from B?

Answers: (1) While there is room for difference of opinion, from the trictly ethical point of view, the acceptance of B's retainer, under the conditions named, should be regarded as so questionable as to be unwise and improper.

(2) In any event, assuming that, as stated, the matters in regard to which the engineer is employed by A and sought to be retained by B have no connection with, relation to, or bearing up each other, the engineer should not accept B's retainer without the full knowledge and consent of both A and B.

More Reminiscences of Early Days in the North

By Henry K. Wicksteed
Chief Locating Engineer, Canadian National Railways, Toronto

TO THE north of the St. Lawrence, the Ottawa, and the Great Lakes, lies a country of almost unique characteristics, which occupies a very considerable portion of Canada in the temperate zone, and is generally referred to as the Laurentian range of mountains or hills—"mountains" is rather a misnomer, for there are few elevations of more than 2,500 feet above the sea, or more than one-half that above the adjacent valleys. Hills there are in plenty in the southern portion, and they make up in number what they lack in elevation. This southern portion is extraordinarily rough and broken, and presents a very bold front to the more hospitable country which borders it, and especially to the Lower St. Lawrence, the Saguenay and Lake Superior. This bold front is somewhat forbidding and awe-inspiring, but if we penetrate into it by some of the numerous rivers, we find that it is not so bad as it looks from the outside, nor so inhospitable.

Great Natural Resources

There is a great wealth of timber in this country. For some centuries it was Canada's principal source of wealth on this account, not merely because of the direct value of the timber itself, although this was enormous, but because these forests sheltered the fur-bearing animals, the marten, the mink, the fisher, the otter, the wolf, and more important than all, the beaver, the one-time emblem of Canada, and more than any one thing in the animal, vegetable or mineral world, responsible for Canada's early settlement and development.

Among these rugged hills are fertile valleys, and pushing on up the streams which occupied these valleys, the early explorer found that after he had surmounted the first swift ascent by a series of arduous portages, the rapids became less numerous and formidable; lake expansions became more numerous and larger, and the hills relatively lower and less rugged. Instead of being brought up finally by a range of mountains and having to abandon his canoe, these lakes and their connecting streams brought him to a great plain through which the streams meandered with sluggish current, and the lakes stretched often beyond the horizon. Pushing onward, still northward, sometimes without a portage, he found the current reversed and discovered that he was being carried forward toward the great bay of the north. The streams combined to form rivers, and the rivers grew larger and larger, and swifter and more turbulent, until he debouched at last by one of such estuaries as that of the Moose or the Albany into salt water. To Moose Factory from Montreal by the Ottawa and the Abittibi, or to Rupert's House from Quebec by the Saguenay and the East Main, was a long journey in the early days of Canada, but it was not too long for Iberville to conduct a successful war party to the shores of the bay, living on the country as they travelled, nor for the Jesuits on their evangelizing missions to the Indians.

Necessity for New Railroads

When the great plains of Central Canada were opened up to agriculture, and the several colonies were combined as the Dominion of Canada, railways became a

necessity, and the ragged outcrop of the great northern plateau became somewhat of a hindrance and deterrent. It has been designated the Great Barrier. But this was true only of the southern outcrop, which, being nearest to the older settlements and commercial routes, and affording, on the map at any rate, the shortest route, was naturally that first essayed. The more recent lines of the Canadian National, striking boldly north have found it much less of a barrier. On the contrary, they have opened up a country with considerable natural resources in timber and minerals, and which will perhaps be, in the future, as it has in the past, much more of a factor in the industrial development of Canada than the prairies themselves.

Greatest among the industries which have grown up are the nickel mines of the Sudbury district. Next come the silver and gold of Cobalt and Porcupine, and simultaneously there has gone on the agricultural development of the "clay belt" and its outlying oases. Much less talked about has been the increasing output of the forest—railway ties, pulpwood, piles, and sawn lumber. Complementary to these industries has been and will be still more in the future, the development of the water-powers. A good deal has already been done on the Wahnapitae, the Spanish, and the Mattagami, the St. Maurice and the Chicoutimi. More is in progress on the Nipigon; but this is only a beginning, and some of the most important, besides an enormous number of secondary powers, have scarcely been considered at all. They are waiting their chance to be made useful, and with the advent of population and capital they will soon get it.

So far from this northern country being a barrier, it will probably become one of the busiest and richest districts of the Dominion, as it is the greatest in area. The agricultural plains of Central Canada will drop into a secondary position as food producers for the industrial population east and west, as have the corresponding districts in the United States. So far, too, from being a barrier, the National Railways lines through this country have actually cost less per mile than through much of that east and west—less than through the canyons of British Columbia, or even between Montreal, Toronto and North Bay, while from the point of view of economical operation, they are equal in standard to any in the world.

It is in this north country that much of the writer's life has been spent. Forty years ago it was almost unknown and unmapped. The Geological Survey had traversed some of the main canoe routes, and the early surveys of the Canadian Pacific had fixed the position. But only the Indian names of some of the great rivers and lakes were mentioned from time to time as existing somewhere in this mysterious northern district, and it has fallen to the writer's lot to do much of the exploration and mapping. The exploration took time and patience, and led to some hardship and privation, and a little danger at times. Always it was hard work. But hard work in conjunction with youth, good health and appetite is rather pleasant than otherwise, and the explorer's lot is not altogether an unhappy one, although there is variety in this respect.

One sunny day about the middle of June in the year 1884, there might have been seen entering the mouth of one of the northern affluents of Lake Superior, a Peterboro canoe manned by three men. Technically, one of these, the steersman, was a white man, another in the bow was red, the third was a halfbreed—between the two both in position and color. But, practically, they all looked the same. The bowman's name was Louis, a nice, quiet boy and a good worker, albeit he had been implicated in the killing of a relative not long before. Paul was the midshipman, a merry, light-hearted fellow, with a neck like a bull, and tremendously powerful, and in character reckless and headstrong, more white than Indian. Modesty forbids any description of the steersman.

We say "might have been seen" advisedly, but as the north shore at that time was one of the loneliest places in the world, it is extremely unlikely that any one did see them. Indians there were and still are, in this country, but they do not affect the shores or waters of the Great Lake, except at one or two established trading posts. The shores are so terribly rough and broken, and the vegetation so scant and subarctic, that game and fur-bearing animals are scarce. Only the waters teem with fish life. But this is equally true of the kindlier country inland, studded as it is with lakes of all shapes and sizes, which are better suited to navigation by the aboriginal bark canoe.

Capsized in the Eddies

The Little Pic was high, and was pouring a heavy brown flood into the lake over a bar at its mouth, over which the lake swells broke angrily. For three or four miles the current was very swift, and taxed the energies of the paddlers, dodging from eddy to eddy. Towering bluffs of granite rose 500 or 600 feet on the left from the water's edge, and others gradually closed in from the right, until the valley became a canyon, and over its boulder-strewn bottom the river poured in a turbulent rapid. Then our troubles commenced. There were signs of an old overgrown portage along the talus slope, but to carry a heavy canoe and a full cargo over such a portage is a work of time and labor, and we concluded to "track" as far as possible. A long light line was got out forward, and Louis sent ahead as far as it would reach. Paul held on to the canoe until he had braced himself for a pull, and the writer hovered between, ready to "fend off" from the rocks. When all was ready, Paul pushed the canoe out of its protecting eddy, Louis pulled, and the third party fended. The bow of the canoe rose gallantly against the rush of water, and slowly advanced up stream until she rested in another eddy at Louis' feet. The process was repeated time after time, and the upper end of the rapid came into sight, but then Paul became overconfident and reckless, and pushed out before Louis had a strain on his line, the canoe sheered out into the current, nearly broadside on. Louis hung on, instead of easing off and gradually getting her nose upstream, the strain on the line became terrific, and she gradually heeled over to it, and the water poured in over the gunwale. Then the deckload, consisting of a side of bacon and a flint-lock musket, slid overboard, and the canoe righted, but full of water. A bag of flour and a pack of blankets floated off. Then the canoe came ashore in a shamefaced sort of way, and was quickly emptied, and we started after the missing articles. The blankets soon became saturated and lagged in the eddies, and were easily caught, but the flour sailed away down those rapids at a surprising pace, and was nearly at the mouth of the river before being caught. Flour in a bag does not seem to the uninitiated as if it should be a very buoyant material

and one would expect it to become semi-fluid and quickly dissipated, but as a matter of fact, when tightly packed and fastened, it soaks up very little water, and an impervious paste forms next the bag, so that very little is lost, and heavy as it seems to a man standing underneath it, it is much lighter than an equal quantity of water, and floats quite high, so that we were not greatly concerned over the wetting. Our sugar, however, was a complete loss, and the tea almost so.

A Night With the Black Flies

The second time we tackled the canyon rapid we got up with comparative ease, and then for several miles above met only a very strong current. But about ten miles up, we came to a point where a clay bank 75 feet high had been undermined by the flood, and had slipped bodily into the river, carrying trees and bushes with it. The clay had been mostly carried away, but the trees were badly jammed and tangled, and it required an hour or two of work to cut our way through and start the jam moving.

Another few miles brought us to a fall and a short portage, and a short distance above, we camped for the night. This was June, and the latitude 49°, and it was the first warm spell of weather of the summer, and the trees in full leaf. With the leaves come the black flies, unusually hungry and fierce on account of the lateness of the spring breakup. The sun set somewhere about 8 and rose at 4 next morning, and the twilight lasted hours longer, in fact there was practically no darkness, and while the blackfly is supposed to be a gentleman and go to bed at night, he took very little rest that night, and we got even less. And we were glad to get afloat again and reduce the number of the tormenters, although on the now narrow stream it was impossible to leave them altogether behind.

We passed a large branch from the north, and the stream narrowed still more. An hour later passed another. Here the stream not only narrowed, but became clear and brown, showing that we had left the clay country behind. A strong rapid appeared ahead, and a much overgrown portage led from its foot. The writer took the axe and started ahead clearing the growth as he went. A few hundred yards brought him to the river again, above the turbulent water. A tree projected over the water, blocking the landing. The steersman put his foot on it, and swung the axe aloft. A twig caught it and deflected it enough to strike the foot instead of the tree trunk, and a great gash appeared across the toe of his mocassin. In a few minutes the mocassin changed in color from yellow to dark red.

Evidently the game was up for this trip, so he reluctantly hobbled back, launched the canoe again, and started for Lake Superior. Feeling a little faint, and the downstream work being comparatively easy, the steersman took the center of the canoe, and handed over the steering paddle to Paul. The current was very swift, and rounding a bend, a snag appeared ahead. Paul as usual overdid the steering, and brought the canoe broadside onto it. A very sudden capsize ensued, and in a few seconds the writer was pulling the canoe ashore with one hand, while the other and the uninjured foot had to do the propulsion, and the two Indians stood on the bank. Truly, misfortunes never come singly. This time the axe, frying pan and kettle were all gone, and only the blankets and flour remained. One paddle drifted away, but was caught lower down.

With the decreased quantity of impedimenta, getting started again was a very short job, and as the boys began to see hunger ahead of them, it did not need much urging to get them to paddle hard. With the swift current under us, we made great speed. An hour or two brought us to the portage past the fall. As the cut foot had stopped bleeding, and was now stiff and sore, getting across the portage was a painful piece of work. But it was still early in the day when we launched again.

Then came a long stretch of easy going. The day was warm and bright, and the black flies did not bother much on the wide river. I believe I dozed a little, but woke up to find the canoe nearing the canyon, and the sun getting low. The Indians ran the canoe ashore; got out, and looked inquiringly at me. But I wanted no more portages, and before they could protest I had braced my good foot against the thwart ahead of me, my back against another, and shoved out into the stream. Two strokes straightened the canoe out, and in a moment she was whirling down the half-mile rapid, grazing boulders by fractions of an inch and shipping water over both gunwales in the surges. But a few seconds did the trick, and I was floating in an eddy at the foot of the rapid before the boys started to scramble through the brush.

Half an hour later we floated out on the broad expanse of Superior, and headed for a sandy beach. The sun was nearly down now, and it was a glorious evening. But we were very hungry indeed, and it did not seem to me that the chances for supper were bright. However, the Indians met the emergency. Axe we had none, but there was lots of driftwood, and we had some dry matches; frying pan was gone, but the flour was still with us, and they made dough; rolled it out very thin; wrapped it around little sticks, and set the sticks up in the sand. In a few moments it was cooked in a way, and to a hungry man, eatable. And then we lay down on the sand, and as the icy chill off the lake kept the flies away, we slept, and slept soundly.

Home At Last

In the morning we were off betimes, and found a dead calm and a brilliant sun. Our luck seemed to have turned at last, and by 2 p.m. we had covered the 25 miles to the Pic River, and were crossing the bar into the river. Kind hearts had the Spences of the H. B. C. post, and in a few moments we were at home. Warm water and sharp scissors got the mocassin away from the foot without taking the toes with it, but one was nearly severed, and another badly nicked. There was no doctor, but we were semi-savages, and for such, savage remedies are sometimes best. An old squaw of ripe experience, and even riper odor, bound the toes up in some kind of shape, overlaid the cut with the castor of the beaver, and left the Lord to do the rest. In three days I was in good enough shape to steer a boat and look after supplies, and in ten I was walking with the aid of a stick. But perhaps if I had not been out all the previous winter, and living on bread and tea and fresh air, my mutilated foot would not have healed so promptly.

It was rather a tough trip anyway, and while I have had harder, and been for some days without even warm dough to eat, I don't remember ever meeting with such a succession of petty mishaps, which might have resulted in tragedy.

Present Position of Engineering

*(The following extract from the inaugural address of Burnard Green, president of the Society of Engineers, Great Britain, shows that some of the lines of thought on the status of the engineer in England are being paralleled in this country. Apparently the conditions surrounding the profession there and here are much alike.—*EDITOR.*)*

In considering the calling pursued by an engineer it is impossible to say definitely that he is following either a business or a profession. Uncertainty upon this point is in itself a great handicap, and has in the past given rise to a great deal of ill-directed training. An engineer is not following a profession in the same manner as a doctor or a barrister, while he is not protected by a corresponding organization to that which protects and watches over the interests of the members of the accepted professions. If an engineer is to make good in the great world of affairs some business training should be an integral part of his experience, to which as much importance should be attached as to the acquisition of some of that technical knowledge which he acquires, often at great pains, believing that it will be sufficient to enable him to earn a living.

It is remarkable that there are numbers of men, highly skilled technically, and of considerable mental attainments, who do not command that feeling of confidence that others with less technical skill and greater knowledge of the world's affairs do command, and it is merely human nature that the commission does not always fall into the hands of the person most highly skilled technically. It does not follow that the most highly skilled technical advice is the most valuable in all circumstances. A nicely balanced knowledge of the world's affairs is often of greater value than higher technical knowledge in dealing with problems put before the engineer today.

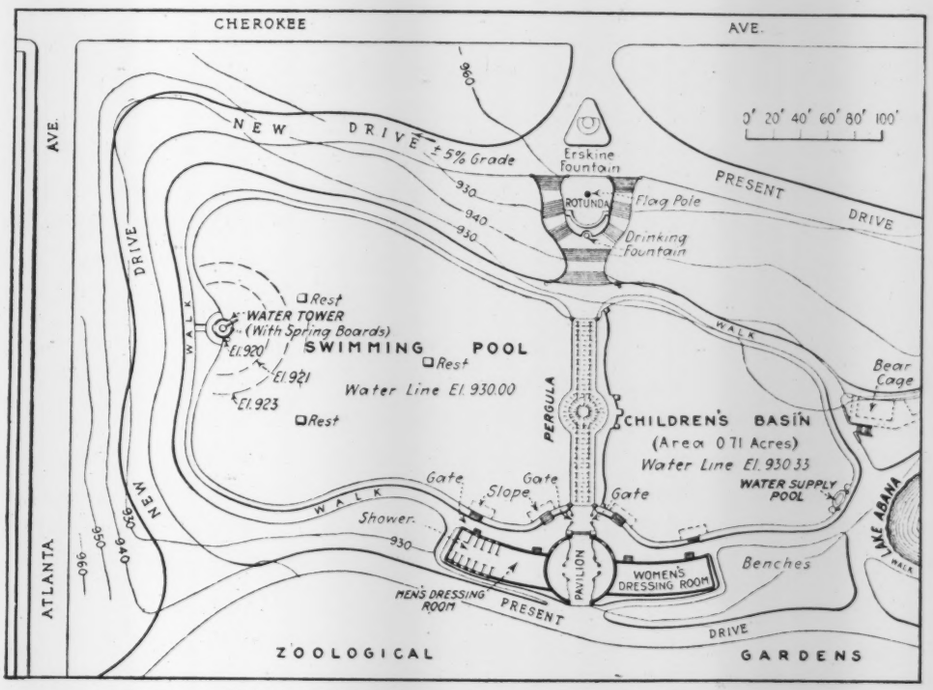
In considering the benefits resulting from the labors of our many-sided profession, it is important to bear in mind that, though civilization has developed in a particular manner and direction as the result of it, development would, nevertheless, have taken place without it, but probably on other lines. There are, in fact, no good grounds for thinking that the world would have been less civilized. Though the world at large is more indebted to the labors of engineers for the progress of civilization than to those of any other profession, it is perhaps true that our profession meets with less popular appreciation and material rewards than any other. It is not an uncommon belief, among large portions of the community, that an engineer, beyond being a bit of a mathematician, is little else; and there is reason to think that this idea has been nourished, if not created, by the dislike which many engineers openly show for certain matters accurately pertaining to their professional work, but not perhaps of the most interesting kind to some natures.

I am speaking especially of commercial consideration in connection with engineering schemes, and I am of opinion that it would be of great advantage if the future training of our young engineers made definite provision for obtaining the necessary experience and knowledge of this kind, without which it is extremely unlikely that they will ever succeed in the world of commerce in which the engineer occupies an important position. An elementary knowledge of accountancy and modern commercial methods cultivates a sense of proportion of values of engineering work, and it is an essential possession which can be cultivated. The extent to which this is of assistance can only be apreciated by one who has taken the trouble to attain it; and when a man has taken the trouble to attain it, it is safe to say that he will be kept wondering how he ever managed to get on without it.

The ability to value work accurately is the result of wide experience, and can only be obtained as years go by; but it is within the power of every young engineer to start his professional life with a fair idea of monetary values, and it is a branch of his work which should never, under any circumstances, be neglected. For good engineering design one must pay attention not only to the sufficiency of the design in the engineering sense, but must at the same time provide this with the minimum expenditure of money spread over the life of the structure.

New Open-Air Swimming and Wading Pools, Atlanta, Georgia

OUTDOOR swimming pools built and maintained by the City of Atlanta, Ga., will be five in number when the one under construction in Grant Park is completed. These pools are supplied with filtered water from the city water-works, on the constant-renewal plan. One of the pools takes 500,000 gal. a day. W. Z. Smith, superintendent of water-works, has recommended that the City Council appropriate money for small pumping and filter plants to treat the swimming-pool water.



PLAN OF GRANT PARK POOL AT ATLANTA

The Grant Park pool, as shown by the accompanying map, is set in a hilly park, and has a curved outline and various accessory features designed to add to its attractiveness. The swimming pool proper is from 5 to 10 ft. deep and the children's basin or wading pool is considerably shallower. The work is being done under H. L. Collier, chief of construction, Atlanta, Ga., after plans prepared by C. E. Kauffmann, engineer of bridges and estimates.

Salt Lake's Five-Year Sewerage Program is Completed

Electric Pumps Discharge Sewage from Interceptor Into Canal Leading to Lake—Sewage Flow Closes Small Leaks

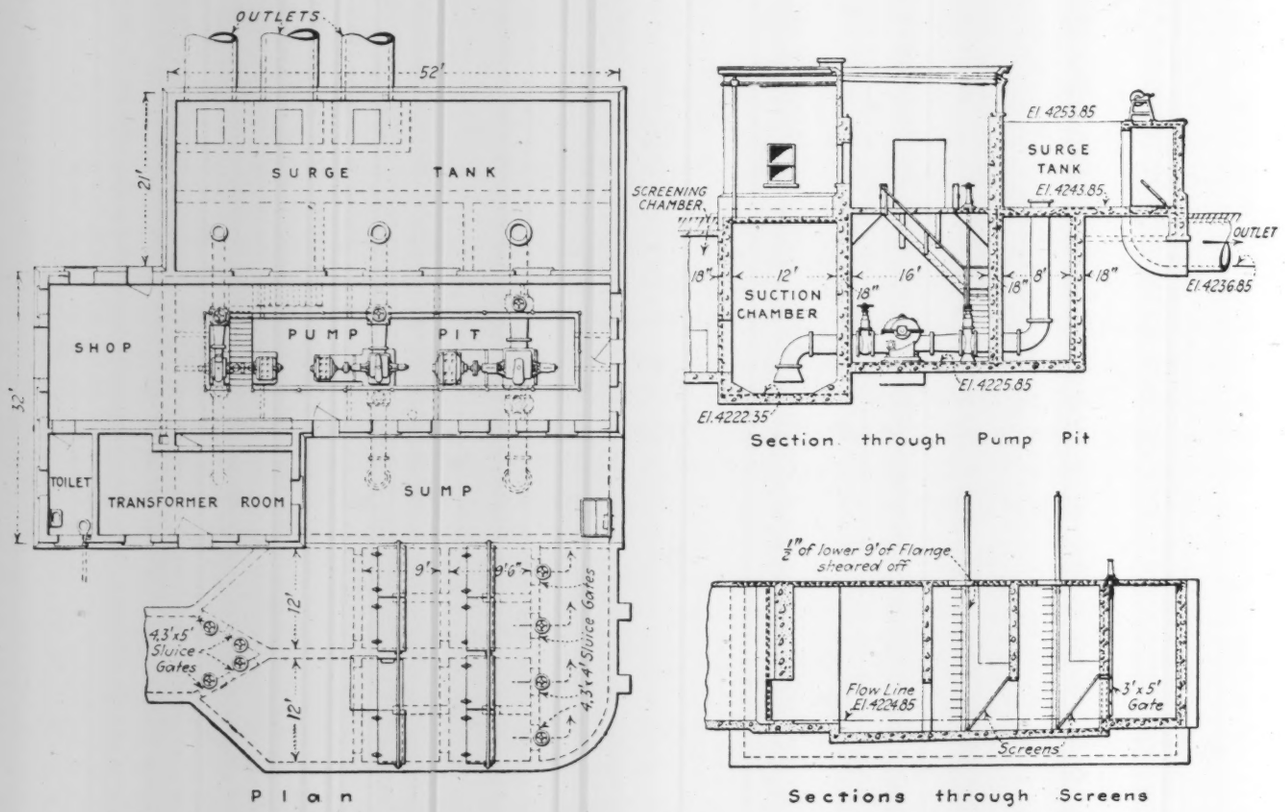
RECENT completion and acceptance of the 16,000-ft. reinforced-concrete siphon outlet of the sewerage system of Salt Lake City, Utah, marks the end of a five-year program which makes provision for 500,000 persons, four times the present population. The salient features in the system are a 78-in. intercepting trunk sewer handling about one-third of the lower level area, the upper portions already being cared for by a gravity system; a pumping station to which the trunk sewer leads, and a 60-in. outfall siphon discharging into a canal emptying into Great Salt Lake.

At the time the improvements were undertaken the major portion of the sewage was being discharged through the gravity sewer into a high-level canal and thence into Great Salt Lake. This flow was augmented by a small flow collected in the lower, growing part of the city and pumped into the gravity line. The interceptor making this collection was badly overloaded. In the five-year period 96 miles of sewers, or about one-third of the total length throughout the city, have been added to the system.

The change in the pumping station was found to be advantageous because the head required could be reduced from 50 to 20 ft. Then, too, by putting in units of 12-, 15- and 25-sec.-ft. capacity, constant instead of intermittent operation would cut down the penalty for maximum demand on the electric power used. Construction of the discharge outlet siphon made the head economy possible and obviated complaints of owners of the land through which an open canal following contours would flow.

In the design of the interceptor, which has a maximum capacity of 130 sec.-ft., provisions were made for the sewage of 500,000 persons and for infiltration from the total area to be served. Storm water is cared for in separate systems, following roughly the old natural watercourses. Measurements made in 1915 indicated that the 4.8 square miles under the gravity sewer gave a maximum flow of 17 sec.-ft. and that from 2.7 square miles under the old interceptor was 9.6 sec.-ft. The area to be drained by the new system was 18 square miles. With an estimated population of 300,000, the 75-sec.-ft. capacity allowed would permit 160 gal. per capita daily to be discharged, checking fairly well with the measured discharge under the two old systems. For infiltration data the Fifth East St. sewer, 4270 ft. long, was measured before any houses were connected. This gave 1.6-sec.-ft. total, or 35-sec.-ft. per day per square mile of street area. As 14 square miles were subject to infiltration, 50-sec.-ft. groundwater was added to the 75-sec.-ft. sanitary sewage. The line is 23,000 ft. long and varies from 60 to 78 in. in diameter, providing a maximum outlet capacity of 130 sec.-ft. for all of the western and southern portions of the city that cannot drain to the gravity sewer. The grades vary from 0.1044 to 0.045 per cent.

Construction of the interceptor was completed in 1917, but householders were not encouraged to connect with it until recently, for temporary discharge into the Jordan River was provided which it was desirable to keep as small in amount as possible, the river flow at this point being low, particularly during the irrigation season.



PLAN OF PUMPING-STATION, SCREEN CHAMBER AND SURGE TANK—CONNECTIONS TO PUMP ARE ALL EASILY ACCESSIBLE

The pumping station includes double screen chambers, a large suction chamber, a narrow pump pit, and a surge tank into the bottom of which the pumps discharge. Wooden bar screens of 2 x 4-in. timbers with 2-in. vertical openings have replaced steel screens having ½-in. bars spaced to give 2-in. square openings because of the difficulty of operating the heavier metal screens.

The pumps are in a pit depressed sufficiently to give a gravity head on the suctions at all times. The 12- and 15-sec.-ft. units are driven by 75-h.p. motors and the 25-sec.-ft. unit has a 125-hp. motor. Space is available to bring the capacity up to that of the interceptor. The static head varies from 14.8 ft. to 25.3 ft. At present, operation is required only about 20 hours per day, the long interceptor acting as a storage reservoir. From 12 to 15 sec.-ft. is the average flow, and in August, when inspected by a representative of *Engineering News-Record*, the sewage was fresh at the pumping station but septic at the end of the 16,000-ft. outlet. The power consumption has been regulated so that it is always below the 752,000 kw.hr. per year free current allowed under the city's franchise agreement with the Utah Light & Power Co. Formerly the old station consumed about $90 worth of power per month at 1c. per kilowatt-hour over and above the free allowance. About 90% of this free power is consumed at the station, and the current consumption is approximately half that formerly used.

Use of the outlet, the delay in the completion of which has held up the operation of the interceptor and the station for more than a year and a half, was not made until February of this year, although construction was completed in September, 1918. The line is built of reinforced-concrete pipe, and the head at the lowest part of the siphon is 20 ft., due to elevation, and about 5 ft. to additional head necessary to overcome friction. Very fine cracks in the joints under 20-ft. head permitted leaks showing 3500 gal. per minute under tests. In spite of extended repair of these leaks, the contractor could not reduce the leakage materially, and finally the city made an arrangement with him to take over the line, with the hope that the sewage might seal the cracks. Satisfactory results were obtained, the last tests made in February indicating a leakage unmeasurable by the weirs used at inlet and outlet. The normal capacity is 50 sec.-ft., and a second line is to be installed to meet the trunk-line capacity at a future date not yet definitely fixed.

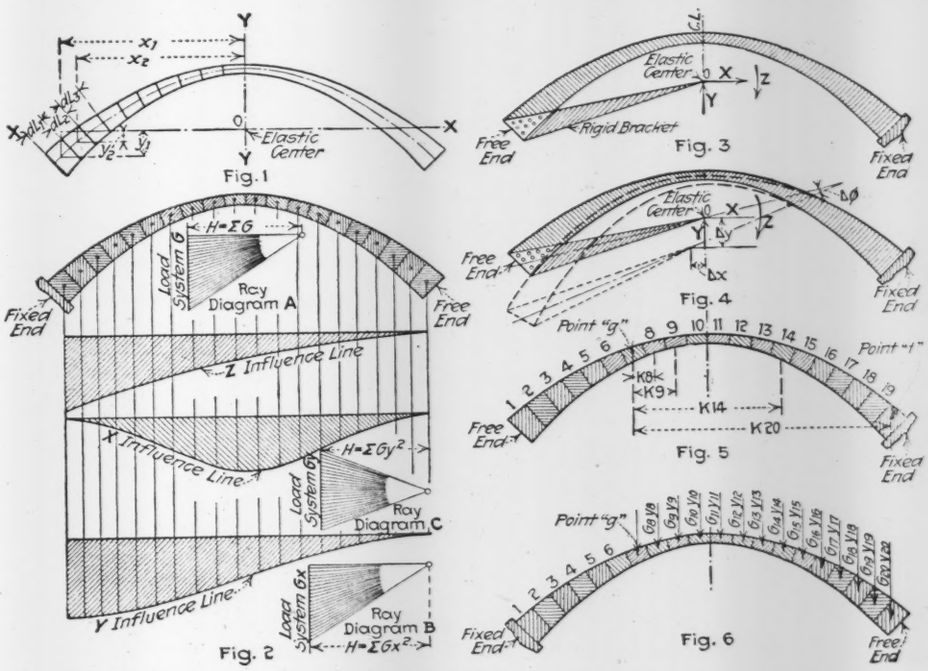
Gibbons Bros. and Reed & Roche were contractors for the main trunk sewer; the Lynch-Cannon Engineering Co. built the pumping station, and J. W. Mellen had the contract for the discharge outlet. The design and the construction were handled under the direct supervision of S. Q. Cannon, city engineer.

Arch Reaction Influence Lines by Deflection Diagrams

Dividing Arch Center Line Equally, "Elastic Weights" Are Used in Connection With Elastic Center for Graphical Solution

BY C. B. MCCULLOUGH
Bride Engineer, Oregon State Highway Commission, Salem, Ore.

APPLYING the fundamental principle that the influence line for any reaction is identical with the deflection diagram produced by unit displacement at the point of application of that reaction (see *Engineering Record* of Nov. 25, 1916, p. 648), the bridge department of the Oregon State Highway Commission has been standardizing methods of analysis of indeterminate structures. The following analysis for fixed-end arches has been developed. It is analogous to that described by C. S. Whitney in *Engineering Record* of Sept. 11, 1915, p. 324, but differs in the use of variable "elastic weights" or "rotation loads" and in the treatment of the unknowns.



FIGS. 1 TO 6. DIAGRAMS AND NOTATION FOR FINDING ARCH REACTIONS BY INFLUENCE LINES

Briefly, the method is as follows:

1. The half arch rib is first divided into not less than ten equal divisions dL and for each segment the quantity dL/I is computed. The term I represents the moment of inertia of the cross-section of the rib at the midpoint of the linear segment dL, including the reinforcing steel. This term dL/I, the "*rotation load*" or "elastic weight," will be designated by the letter G.

2. Having these rotation loads computed, the center of gravity of the same is next determined, which point may be called the *elastic center* O of the arch system.

3. Through the elastic center thus determined, construct two coördinate axes, $X - X$ horizontal and $Y - Y$ vertical Fig. 1. Carefully scale and tabulate the terms Gx, Gy, Gx^2, Gy^2 for each section, calling y positive above axis $Y - Y$. Also determine the summations ΣG, ΣGx^2, and ΣGy^2 for the entire arch.

4. Next consider the arch as a cantilever fixed at the *left end* as shown in Fig. 2 and construct the following three equilibrium polygons: (1) Polygon A with loads G and pole distance ΣG; (2) polygon B with loads Gx and pole distance ΣGx^2; (3) polygon C with loads Gy and pole distance ΣGy^2.

Now consider the arch as a cantilever fixed at the *right end* and conceive a rigid bracket fastened to the free end and terminating at the elastic center O. Also conceive three forces, X horizontal, Y vertical and a moment couple Z acting at O as shown in Fig. 3.

It can easily be proved that polygon A is the influence line for the moment couple Z. Also that polygon B is the influence line for the force Y and polygon C the influence line for the force X. From these three influence lines the influence lines for thrust and for bending moment at any point on the arch rib are easily drawn. Thus, the bending moment due to the left reactions would be

$$M_r = Z - (Yx + Xy)$$

A rise in temperature induces a reaction X_t but, for symmetrical spans, no reaction Y or moment couple Z. For a rise of t degrees in concrete arch spans

$$X_t = \frac{12tL}{\Sigma Gy^2}$$

Underlying Theory

The theory underlying the above method is demonstrated as follows:

Consider the support at the left end removed and the rigid bracket fastened to the terminal section as shown in Fig. 4. Since the supports are known to be rigid and unyielding, the forces X, Y and the moment couple Z applied to the bracket must be sufficient to counteract the indicated deflections Δ_x, Δ_y, and $\Delta\phi$, and therefore must be proportional to these displacements. It is apparent therefore, that an influence line constructed for the displacement Δ_x is also the influence line for the force X applied at O.

In a similar manner, the influence line for the displacement Δ_y is also the influence line for the force Y, and that for the rotation $\Delta\phi$ is the influence line for the moment couple Z.

Let m_x be the moment at any section due to a unit load applied at O along the line of action of the redundant X; m_y be the moment at any section due to a unit load at O acting along the line of action of Y and m_z the moment due to a unit couple at O acting in the direction Z. Obviously,

$$m_x = y;\ m_y = x;\ m_z = 1.0$$

From the theory of deflections

$$\Delta_x = \Sigma \frac{Mm_x dL}{EI} = \Sigma \frac{My dL}{EI} = \frac{I}{E}\Sigma MGy$$

For a unit load at any point, say point g (Fig. 5) ΣM becomes $\Sigma' {}_g K$, whence

$$\Delta_x = \frac{I}{E}\Sigma' {}_g KGy$$

But this last expression is equal to $1/E$ times the bending moment obtained at point g, were the catilever to be considered as fixed at the *left support* and loaded with the rotation load system Gy, Fig. 6.

The moment diagram for the load system Gy is therefore an influence line for the redundant x.

The scale of this influence line may be determined from the following consideration: A unit load applied horizontally at O will cause a displacement represented by the term

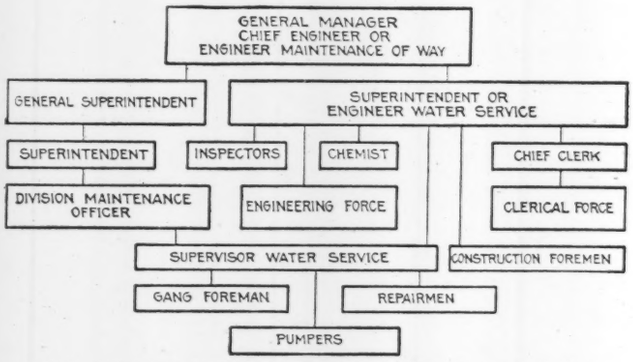
$$\Delta'_x = \Sigma \frac{m_x^2 dL}{EI} = \frac{I}{E}\Sigma Gy^2$$

Now, since the reaction X is proportional to the displacement Δx, $X : 1 :: \Delta x : \Delta x'$. Whence $X = \Delta x/\Delta' x$. Since E cancels out and the summation term for Δx equals the intercept in polygon C times pole distance, if the pole distance be made ΣGy^2, the summation term for $\Delta' x$, the intercepts will truly represent the reactions X.

Therefore polygon C constructed with the load system Gy and the pole distance ΣGy^2 is the *true* influence line for the redundant X, to the same scale as the beam diagram. In a similar manner the relationship stated for polygons A and B can be demonstrated.

Railway Water Service Organization

A water service organization suitable for large railways, but capable of being modified for application to smaller roads, submitted with the report of the committee on water service, was adopted at the annual meeting, last month, of the American Railway Engineering Association. This was planned by C. R. Knowles, Illinois Central R.R., and is shown on the accompanying



ORGANIZATION FOR A RAILWAY WATER SERVICE DEPARTMENT

diagram. It does not involve material change in the division or local forces but aims at placing the duties in the hands of men trained in particular lines, relieving local or other officers of duties which may be foreign to their departments. Where the nucleus of an organization exists, as is the case on many railways, the principal change would be a more clear definition of duties and responsibilities.

Efficient organization and the economical development, construction, maintenance and operation of water stations supplying water for locomotives and other railway purposes, are the objects of the proposed plan. The superintendent or engineer of water service is in general charge and acts in an advisory capacity to the division forces. He would approve city water bills, requisitions for materials and agreements relating to water supply. The chemist has supervision of water treatment and the analysis and examination of water, checking the results of treatment and the effect of treated water on the performance and maintenance of boilers. Inspectors are to inspect both water stations and construction work. The supervisor of water service is responsible for pumping machinery, tanks, fire pumps, pipe lines and other facilities in his territory.

Disciplinary Procedure of the American Institute of Architects

By Horace Wells Sellers
Fellow, American Institute of Architects, Philadelphia

THE reconsideration of the principles or professional ideals that should govern the relations of the engineer to his fellow practitioners and to the public, and the disciplinary procedure whereby these principles may be enforced within the membership of the engineering societies, has directed attention to the standards of practice promulgated by the American Institute of Architects.

While personal and professional standing as well as technical ability is expected of candidates for membership in the institute, at the same time under the influences of circumstance and environment, a practitioner may be lead away from the principles or ideals of his profession.

To maintain its principles of professional conduct so far as possible without petty interference with the rights of the individual, the constitution of the institute provides that it shall from time to time adopt a code or codes which shall be standards of good practice, and as these are embodied in the by-laws to which all candidates for membership must subscribe, it is necessary to provide a disciplinary procedure whereby these principles shall be maintained.

Circular of Advice

The attitude of the American Institute of Architects on this question is clearly expressed in "A Circular of Advice Relative to Principles of Professional Practice and Canons of Ethics." In it a distinction is made between the general principles of practice which should govern the architect in his several relations but which are conceded to be largely matters of self-discipline in maintaining the ordinary standards of professional practice, and the Canons of Ethics, which, on the other hand, are mandatory obligations of membership and infractions of which are therefore subject to the disciplinary procedure established under the constitution and by-laws.

The Circular of Advice is a statement of principles covering such matters as the architect's relation to his client, charges, payments, duties to the contractor, acceptance of commissions or favors, gratuitous service, advertising and publicity, competitions, undertaking the work of others and duties to the public and to building authorities. The Canons of Ethics enumerates briefly certain unprofessional practices. Both are given in full in appendix A.

The circular is distributed periodically to the members of the institute in order that these principles may be familiar to all and especially that they may be helpful to those whose environment places them in a great degree under the influence of the larger body of practitioners outside of the institute membership and the public they serve, and perhaps less generally actuated by the institutes' professional ideals and standards of practice.

To enforce the mandatory principles embodied in the Canons of Ethics, violation of which constitutes unprofessional conduct, the constitution and by-laws provide for a disciplinary procedure as follows:

Art. VII, Sec. 3 of the constitution:

All questions of discipline of a member shall be submitted to the Board of Directors, which shall decide finally and without recourse any questions of action conflicting with the constitution or by-laws of the institute or of the member's chapter, non-payment of dues to institute or chapter, or questions of unprofessional conduct; and acting under this section the Board may suspend a member, pass a vote of censure upon him, drop his name from the roll of members, or expel him; but no such action shall be taken until the accused shall have had an opportunity to be heard in his own defense.

Art. IV, Sec. 2 of the by-laws:

All questions of discipline of a member shall be determined in accordance with the following procedure:

It shall be competent for and shall be the duty of any member or committee of the Institute or of any chapter to bring to the attention of the Committee on Practice any alleged unprofessional conduct on the part of any member without being deemed to have entered a formal complaint against such member. The Committee on Practice shall, when its attention is drawn to any such matter, conduct a preliminary examination into the facts, and if a prima facie case shall appear against a member, it shall so report to the Judiciary Committee. The Judiciary Committee shall hear and adjudge every case so reported to it and shall give the member an opportunity to be heard in his own defense. Its findings shall be conclusive in regard to all questions of fact involved in the evidence submitted.

The Judiciary Committee shall report its findings to the Board of Directors. If the findings are adverse to a member, the Board of Directors shall take such action thereon as it shall see fit according to the constitution. A member may appeal in writing to the Board of Directors on questions of professional or ethical policy.

Any member may appeal to the Committee on Practice from any action of a Chapter Executive Committee regarding alleged unprofessional conduct. In such case the procedure shall be as provided above in this section, but no decision of the Committee on Practice or the Judiciary Committee reversing the previous action of the Chapter Executive Committee shall be effective unless ratified by the Board of Directors. The action of the Board of Directors shall supersede the action of the Chapter Executive Committee.

If in any case pending before either the Committee on Practice or the Judiciary Committee, any oral testimony has actually been given, such committee shall have the power to continue and conclude its work on that particular case, notwithstanding the expiration of the term of office of any or all of its members.

The Board of Directors shall, from time to time, establish rules of procedure for the guidance of the Committee on Practice and the Judiciary Committee.

It may be stated here, that the institute is an association organized locally into chapters which may be incorporated under the laws of the respective states in which they are established and which, while having their own individual organization, are governed by the by-laws of the institute so far as the national body is concerned. At present every member elected to a chapter becomes a member of the institute, or vice versa, although they may still have associate members who have not qualified for membership in the institute. These chapters exercise disciplinary control over their members and dispose of cases which do not involve the suspension or expulsion except in instances where the offender is a member of the chapter only.

The institute as the national body, in the exercise

of its disciplinary function under its constitution and by-laws as cited, has formulated rules for the guidance of its two disciplinary committees, namely, the Committee on Practice and the Judiciary Committee. These rules are largely an amplification of the procedure set forth in Art. IV, Sec. 2, of the by-laws, and are distributed periodically to the members, or as occasion may require, in the presentation of charges against a member.

At present the Board of Directors has under consideration a revision of these rules, not with a view to modifying the basic principles or standards or to moderate the penalties, but rather with a view to shortening the period now required in which to dispose of a case, and also to give the accused member a hearing before the board at the meeting at which the report of the Judiciary Committee on his case is presented for final action.

Pending this revision the rules now in force are not unreservedly recommended, but are presented in abstract (see Appendix B) to indicate the general procedure, and it is expected that the new rules will be available for distribution after May 15.

ENFORCEMENT

Under this procedure, violations of the principles and canons of the institute which constitute unprofessional conduct subject the offender to discipline varying, according to the gravity of his offense, from censure to suspension and expulsion.

"The qualifications for membership in the Institute have so far tended to bring into association practitioners who are generally in accord with the professional ideals on which these qualifications rest, and in consequence the cases that call for disciplinary action are comparatively few and rarely call for extreme penalties. This is borne out by the fact that during the last five years, for example, there were but 21 cases acted upon by the disciplinary committees of the institute and disposed of as follows, according to the gravity of the offense: Expulsions 1, suspensions 3, censured 13, acquittals 4.

"To illustrate the procedure, specific applications of the disciplinary rules have been selected with the assistance of E. C. Kemper, executive secretary of the institute, as applying to cases of unregulated competition, false claim of authorship and where a member has offered to divide commissions."

As already pointed out every applicant for membership in the American Institute of Architects agrees in writing to be bound by its constitution and by-laws and its "Principles of Professional Practice and the Canons of Ethics" and thereby fulfill his obligations of membership and honorably maintain the institute's ideals in all of his professional relations. These obligations, as well as the privileges of membership, being thus made clearly known from the outset and accepted and supported by common consent, it so happens that where penalties have been imposed, they have been generally accepted as just, and in no single case has the offending member carried an appeal to the civil courts. In a few instances threats of such an intention have been made, but they have never resulted in such action.

While the institute represents but a relatively small proportion of the practicing architects of the country, the standards of membership that it has aimed to maintain and the influence of its members in their respective communities, has done much to widen public appreciation of sound professional ideals which are for the benefit of the client as well as the architect. This right understanding of professional relations was fostered in no small degree under the original organization of the chapters which in their several grades of membership, were steps leading toward final qualification for membership in the institute, and by upholding its standards of personal and technical qualifications for membership the institute has done much for the advancement of architecture as a profession.

Appendix A—Circular of Advice

1. On the Architect's Status.—The architect's relation to his client is primarily that of professional adviser; this relation continues throughout the entire course of his service. When, however, a contract has been executed between his client and a contractor by the terms of which the architect becomes the official interpreter of its conditions and the judge of its performance, an additional relation is created under which it is incumbent upon the architect to side neither with client nor contractor, but to use his powers under the contract to enforce its faithful performance by both parties. The fact that the architect's payment comes from the client does not invalidate his obligation to act with impartiality to both parties.

2. On Preliminary Drawings and Estimates.—The architect at the outset should impress upon the client the importance of sufficient time for the preparation of drawings and specifications. It is the duty of the architect to make or secure preliminary estimates when requested, but he should acquaint the client with their conditional character and inform him that complete and final figures can be had only from complete and final drawings and specifications. If an unconditional limit of cost be imposed before such drawings are made and estimated, the architect must be free to make such adjustments as seem to him necessary. Since the architect should assume no responsibility that may prevent him from giving his client disinterested advice, he should not, by bond or otherwise, guarantee any estimate or contract.

3. On Superintendence and Expert Services.—On all work except the simplest, it is to the interest of the owner to employ a superintendent or clerk of the works. In many engineering problems and in certain specialized esthetic problems, it is to his interest to have the services of special experts and the architect should so inform him. The experience and special knowledge of the architect make it to the advantage of the owner that these persons, although paid by the owner, should be selected by the architect under whose direction they are to work.

4. On the Architect's Charges.—The Schedule of Charges of the American Institute of Architects is recognized as a proper minimum of payment. The locality or the nature of the work, the quality of services to be rendered, the skill of the practitioner or other circumstances frequently justify a higher charge than that indicated by the Schedule.

5. On Payment for Expert Service.—The architect, when retained as an expert, whether in connection with competitions or otherwise, should receive a compensation proportionate to the responsibility and difficulty of the service. No duty of the architect is more exacting than such service, and the honor of the professior is involved in it. Under no circumstances should experts knowingly name prices in competition with each other.

6. On Selection of Bidders or Contractors.—The architect should advise the client in the selection of bidders and in the award of the contract. In advising that none but trustworthy bidders be invited and that the award be made only to contractors who are reliable and competent, the architect protects the interests of his client.

7. On Duties to the Contractor.—As the architect decides whether or not the intent of his plans and specifications is properly carried out, he should take special care to see that these drawings and specifications are complete and accurate, and he should never call upon the contractor to make good oversights or errors in them nor attempt to

shirk responsibility by indefinite clauses in the contract or specifications.

8. On Engaging in the Building Trades.—The architect should not directly or indirectly engage in any of the building trades. If he has any financial interest in any building material or device, he should not specify or use it without the knowledge and approval of his client.

9. On Accepting Commissions or Favors.—The architect should not receive any commission or any substantial service from a contractor or from any interested person other than his client.

10. On Encouraging Good Workmanship.—The large powers with which the architect is invested should be used with judgment. While he must condemn bad work, he should commend good work. Intelligent initiative on the part of craftsmen and workmen should be recognized and encouraged and the architect should make evident his appreciation of the dignity of the artisan's function.

11. On Offering Services Gratuitously.—The seeking out of a possible client and the offering to him of professional services on approval and without compensation, unless warranted by personal or previous business relations, tends to lower the dignity and standing of the profession, and is to be condemned.

12. On Advertising.—Publicity of the standards, aims and progress of the profession, both in general and as exemplified by individual achievement, is essential. Advertising of the individual, meaning self-laudatory publicity procured by the person advertised or with his consent, tends to defeat its own ends as to the individual as well as to lower the dignity of the profession, and is to be deplored.

13. On Signing Buildings and Use of Titles.—The unobtrusive signature of buildings after completion is desirable.

The placing of the architect's name on a building during construction serves a legitimate purpose for public information, but is to be deplored if done obtrusively for individual publicity.

The use of initials designating membership in the Institute is desirable in all professional relationships, in order to promote a general understanding of the Institute and its standards through a knowledge of its members and their professional activities.

Upon the members devolves the responsibility to associate the symbols of the Institute with acts representative of the highest standards of professional practice.

14. On Competitions.—An architect should not take part in a competition as a competitor or juror unless the competition is to be conducted according to the best practice and usage of the profession, as evidenced by its having received the approval of the Institute, nor should he continue to act as professional adviser after it has been determined that the program cannot be so drawn as to receive such approval. When an architect has been authorized to submit sketches for a given project, no other architect should submit sketches for it until the owner has taken definite action on the first sketches, since, as far as the second architect is concerned, a competition is thus established. Except as an authorized competitor, an architect may not attempt to secure work for which a competition has been instituted. He may not attempt to influence the award in a competition in which he has submitted drawings. He may not accept the commission to do the work for which a competition has been instituted if he has acted in an advisory capacity either in drawing the program or in making the award.

15. On Injuring Others.—An architect should not falsely or maliciously injure, directly or indirectly, the professional reputation, prospects or business of a fellow architect.

16. On Undertaking the Work of Others.—An architect should not undertake a commission while the claim for compensation or damages, or both, of an architect previously employed and whose employment has been terminated remains unsatisfied, unless such claim has been referred to arbitration or issue has been joined at law; or unless the architect previously employed neglects to press his claim legally; nor should he attempt to supplant a fellow architect after definite steps have been taken toward his employment.

17. On Duties to Students and Draughtsmen.—The architect should advise and assist those who intend making architecture their career. If the beginner must get his training solely in the office of an architect, the latter should assist him to the best of his ability by instruction and advice. An architect should urge his draughtsmen to avail themselves of educational opportunities. He should, as far as practicable, give encouragement to all worthy agencies and institutions for architectural education. While a thorough technical preparation is essential for the practice of architecture, architects cannot too strongly insist that it should rest upon a broad foundation of general culture.

18. On Duties to the Public and to Building Authorities.—An architect should be mindful of the public welfare and should participate in those movements for public betterment in which his special training and experience qualify him to act. He should not, even under his client's instructions, engage in or encourage any practices contrary to law or hostile to the public interest; for as he is not obliged to accept a given piece of work, he cannot, by urging that he has but followed his client's instructions, escape the condemnation attaching to his acts. An architect should support all public officials who have charge of building in the rightful performance of their legal duties. He should carefully comply with all building laws and regulations, and if any such appear to him unwise or unfair, he should endeavor to have them altered.

19. On Professional Qualifications.—The public has the right to expect that he who bears the title of architect has the knowledge and ability needed for the property invention, illustration, and supervision of all building operations which he may undertake. Such qualifications alone justify the assumption of the title of architect.

Appendix B—Canons of Ethics

The following Canons are adopted by the American Institute of Architects as a general guide, yet the enumeration of particular duties should not be construed as a denial of the existence of others equally important although not specially mentioned. It should also be noted that the several sections indicate offenses of greatly varying degrees of gravity.

It is unprofessional for an architect—

1. To engage directly or indirectly in any of the building or decorative trades.

2. To guarantee an estimate or contract by bond or otherwise.

3. To accept any commission or substantial service from a contractor or from any interested party other than the owner.

4. To take part in any competition which has not received the approval of the Institute or to continue to act as professional adviser after it has been determined that the program cannot be so drawn as to receive such approval.

5. To attempt in any way, except as a duly authorized competitor, to secure work for which a competition is in progress.

6. To attempt to influence, either directly or indirectly, the award of a competition in which he is a competitor.

7. To accept the commission to do the work for which a competition has been instituted if he has acted in an advisory capacity, either in drawing the program or in making the award.

8. To injure falsely or maliciously, directly or indirectly, the professional reputation, prospects or business of a fellow architect.

9. To undertake a commission while the claim for compensation, or damages, or both, of an architect previously employed and whose employment has been terminated remains unsatisfied, until such claim had been referred to arbitration or issue has been joined at law, or unless the architect previously employed neglects to press his claim legally.

10. To attempt to supplant a fellow architect after definite steps have been taken toward his employment, *e. g.*, by submitting sketches for a project for which another architect has been authorized to submit sketches.

11. To compete knowingly with a fellow architect for employment on the basis of professional charges.

Adopted December 14-16, 1909.
Revised December 10-12, 1912.
Revised April 26, 1918.

Appendix C—Rules for Committees

On account of space limitations rules for the guidance of Committee on Practice and the Judiciary Committee are presented in abstract only.

Rule 1.—When alleged unprofessional conduct is brought to the attention of the Committee on Practice the accused is notified if a *prima facie* case has been made out. The findings include a statement of the case and rule or principle violated.

Rule 2.—The accused may obtain copies of the evidence prior to his hearing before the Judiciary Committee.

Rule 3.—The procedure of carrying the case from the Committee on Practice to the Judiciary Committee which hears the case unless the accused accepts the findings of the Committee on Practice and waives the formal hearing. The latter committee presents the evidence in the case and may call witnesses.

Rule 4.—Absence of the accused does not stop proceedings.

Rule 5.—Accused shall answer questions and failure to do so is considered a violation of the objects of the Institute and is so reported to the Board of Direction by the Judiciary Committee. The board deals with the failure as a violation.

Rule 6.—The Judiciary Committee is the sole judge of the admissibility of evidence as well as its value. Members may be requested to present papers or letters involved.

Rule 7.—Findings of the Judiciary Committee are reported to the accused and Board of Directors, which shall take such action as it may see fit. Before disciplinary measures shall be put into effect the accused is given a chance to appear before the Board on his request within 30 days after notification.

Rule 8.—Appeal from the findings of the Judiciary Committee to the Board may be made within 10 days after receiving notice of the findings. Similarly the Committee on Practice may appeal to the Board.

Rule 9.—All members of the Institute get reports of the findings in the case.

Appendix D—Examples of Discipline

Case 1. False Claim of Authorship.—The Committee on Practice found a *prima facie* case of unprofessional conduct against a member upon charges brought by a chapter of which he was a member. The offense charged is that the firm of which the accused was a member caused to be published in a trade paper a large number of illustrations of work executed by other architects, all attributed to the firm of the accused. While the accused and his partner had worked on some of the buildings in the office of the real architects nothing in the terms of their contract authorized them to claim any degree of authorship. Their work was not such as to justify any such claims. By claiming authorship the accused obtained commissions. No proof in contravention was made, his defense being that the improper publication was an error on the part of the publisher and without the consent of the accused. Against this it was stated that this publication was used by the accused before a church building committee and was the means of supplanting a fellow architect then at work on the plans for the church. The publishers categorically denied the statements of the accused. The Judiciary Committee, after a careful review of the testimony, the accused having failed to appear at the hearing, found him guilty as charged. The Board of Direction expelled him. (May, 1918.)

Case 2. Unprofessional Conduct in Offering to Divide Commissions.—The Committee on Practice found the accused guilty of unprofessional conduct in that he wrote to a party in a certain association requesting aid in procuring business, and offering as pay part of any commission received. He was also found guilty by the same committee of an infraction of the spirit of the Canon of Ethics in that his conduct was prejudicial to the interests of the profession at large. The Judiciary Committee upheld these findings. Appeal on the unprofessional conduct charge was made by the accused explaining that the offer was simply an expression of willingness to pay for service, and that he was in duty called upon to make some suggestion of payment to a man he did not know. Furthermore he was really looking for a business representative and while the letter was thoughtlessly written he believed too much importance had been given to the form of an offer which he thought to be a legitimate endeavor to increase his business. The Board of Directors approved the findings of the Judiciary Committee and suspended the accused for one year. (January, 1918.)

Case 3. Unauthorized Competition.—Charges that the accused had entered into competition for a building, the program for which had not been approved by the Institute's Committee on Competitions. He replied that he did so through inadvertence and carelessness; and expressed his regret for the participation. He also promised to see that the offense was not repeated. The charge was sustained. The Judiciary Committee left the question to the Board of Directors as to how far the statements in defense should be considered in mitigation. The Board censured the accused. (February, 1916.)

Water Power Development Booming in Oregon

Renewed interest in hydro-electric power is manifesting itself in the State of Oregon. Since Jan. 1 twenty-one applications for permits to appropriate water for power development have been received by State Engineer B. A. Cupper. Under these permits it is proposed to develop 600,631 hp., which is about three and one-half times as much power as is now developed in the State. In comparison only eleven applications for power development were received during the whole year of 1919. No doubt the present activity is partly due to the prospect of a Federal water power bill and the supposition that there will be a continuation of the present agreement between the State and Federal Government whereby each party agrees to give the other an opportunity to pass upon the desirability of approving the development before water rights are granted by either the State or the Federal Government.

Strain Gage Measurements on Large Floating Crane

A new 150-ton revolving floating crane, recently built for the Navy Department for use at the Norfolk Navy Yard, was subjected to an elaborate set of strain-gage measurements under load, after its completion last year. According to a report of the test results made by L. J. Larsen and R. L. Templin in "Technologic Paper 151" of the Bureau of Standards, just published, the measurements were satisfactory with respect to accuracy and showed that all stresses in the various members tested are within safe limits. As the structure is statically indeterminate the conclusion had particular meaning. Measurements were made on the deck of the pontoon, on the pintle-tower posts and on various members of the superstructure. A 10-in. Berry strain-gage was used, direct-reading to 0.0002 in. The maximum stresses in the outer edge of the tower legs were found to be 17,000 lb. per sq.in. in compression and 13,500 lb. per sq.in. in tension. A maximum compression of 18,000 lb. per sq.in. was found in the pintle posts. The deck stresses were found to be low and those in the superstructure and in the luffing screws not excessive.

For the Young Engineer—

Straight Talk on Success in Life

Extracts from an address delivered at Princeton University, March 16, at the invitation of the Senior Council. The italics are ours.—EDITOR.

—By Charles M. Schwab

You young men, next year or within a few years at least, will be ready to start out upon an active life of usefulness in this country, and you want to hear from one who has been through the turmoil and strife of industry for many years about what are the qualifications, what are the things that attract attention and what are the things that will lead to your greater and better success in life.

I know that it is very difficult to convince the great majority of people that men who are in active pursuit of life have any other object in view than the making of money. Well, now, boys, that is a great mistake. The real leaders of industry and the real men in life and the real successes in life are not always the men who have made lots of money or a great fortune.

My idea of the successful life is a man who has successfully accomplished the objects for which he set out, to do something that is worthy of a real American man. *Money is often a matter of chance or good fortune and is not the mark of a successful life.* And while I have some money—not much since I paid my taxes, boys—it is not the thing that brings a throb of pleasure or a thrill into my life. And I would not pose as a successful man if that was to be the measure. But when I look about me and see the multitude of friends that I have after forty years of business association with men, when I see the great lines of smoking stacks and blazing furnaces that have come into being because of my interests and activity in life, and when I see a work that I set out to do successfully accomplished and meeting the approval of my fellow-men, then a real thrill comes into my heart and I feel that I have done something worth while. The money one doesn't think about as long as you have enough to pay your bills and keep your business going.

We are reprinting a large part of Mr. Schwab's address because we believe that his message, directed primarily to the young man beginning life's work, will carry inspiration to both young and old. For engineers, especially, is there an invaluable lesson in the remarks of the builder of the great steel industry of Bethlehem.

His views on industrial organization and the management of men, and his manner of expressing them, indicate the possession of a thing which engineers, as a class lack, and for the lack of which they do not become the really big influence in the world's work to which they should aspire. That something, if we are correct in our interpretation, is a broad, human, sympathetic understanding of men. For engineers, young and old, a mere reading of the words that Mr. Schwab spoke is not enough. Our suggestion is this: Picture what manner of a man it was who uttered them. Then spend a few minutes in subjective meditation.

For the man with eyes to see there is no riddle in the rise of the maker of the great Bethlehem works.—*Editor.*

VALUE OF VISION

I was not able to place the quotation myself, but your honored president here, a doctor of philosophy, told me this evening the name of the philosopher who said it, and that was that *there is little that the human mind can conceive that is not possible of accomplishment.* Now, the thing you want to do is to make up your mind what you are going to drive for, and let nothing stand in the way of its ultimate accomplishment. Why, boys, one of the greatest pleasures in life to me is to have the recognition from such a body of young men as you are here tonight to have you say, "We would like to hear something from the man that we think has been successful in some things in life." I had rather have it than millions. It brings more pleasure and more satisfaction.

Now, in my long experience in business life and association with men there are some fundamental things that must not be overlooked. If I were asked to say the most important things that lead to a successful life I should say that first of all was integrity—unimpeachable integrity. No man can ever do anything of any great value in life and have the confidence and approval of his fellow-men or be successful in his undertakings with other business men if he doesn't have the reputation of being a man of honor and integrity; and I don't mean by that that a man shall be so high in the moral and social state of life that he is incapable of any action that might not be regarded as always right, but I have the highest regard for a man who, when he has done something wrong, manfully admits it and constantly sticks to the truth of integrity, however much it may seem to hurt.

I am going to speak of a young man that I regard as the most successful young man I have ever known. And if I did not regard him as the most successful young man that I know, he would not be the President of the Bethlehem Steel Company. I am going to speak of a young man that I have known since he was a man of your age. I refer to Eugene Grace. You may have heard of him—and you baseball fans undoubtedly did—because he came down and played baseball at Princeton many years. He came from Lehigh University. When I first knew him, he was a shoveler of coal with an electric crane.

Whatever may be said of Mr. Grace, you could always depend upon it absolutely that when Mr. Grace said a thing you would know the absolute facts, good, bad or indifferent. And today Mr. Grace stands among the great business men of New York and this country, with the reputation of being a man with absolute integrity and a man upon whom everybody can place the greatest possible confidence.

A CHOICE OF TWO ALTERNATIVES

Now, boys, that is the very foundation of a successful life. With this to start upon, then the other is going to be easy going and easy following. *You can make up your mind to do one of two things: You can have a good time in life or you can have a successful life, but you can't have both.* You have got to make up your mind at the start which of the two you are going to have. There is no royal road to a successful life, as there is no royal road to learning. It has got to be hard knocks, morning, noon and night, and fixity of purpose. Never has there been a time in the history of the wrold when so much opportunity offers for the leading of a successful life as today. What would I not give to be one of your age again and have the opportunity of starting life afresh! *You think the opportunities of the past will not be the opportunities of the future. In that, boys, you make a mistake.*

When I first started in the steel business the whole United States produced only 1,000,000 tons of steel in a year. That was about 1880. In 1890 we had got to 8,000,000, in 1900 to 12,000,000 and in 1920 we have got to 45,000,000 tons of steel annually. Now, we thought twenty years ago that the steel business had reached its zenith. We are just as far from the zenith today during your normal lifetime as we were from the zenith twenty years ago.

I don't say you shall become manufacturers or business

men or professional men—I don't know what you are going to be. But this I do know: That *any man who goes into anything in life and does it better than the average will have a successful life.* If he does it worse than the average his life will not be successful. And no business can exist in which success cannot be won on that basis. If it did exist and nobody could make a proper success or get a proper return from it in life, the business would tend to go out until it would reach a basis on which it could be profitable.

Loyalty

Another important thing is loyalty. Now, that is what you boys in universities and colleges learn. You learn loyalty to your alma mater. You learn loyalty to your fellow-students. You learn loyalty to the friendships that are going to follow you through life. The one thing that you are distinctively in the university is that you are loyal men. Be loyal.

Boys, did you ever stop to think that *a great man in life who has won great acclaim and great reputation is the very man who is willing to share and give the honor to others in the doing of the things that made him great?* The man that will selfishly stand alone and proclaim that he is the man who has done these things never is the man who really did them. My own experience is that there is no real effort in life that is not done better under encouragement and approval of your fellow-men. A man goes along then with greater confidence. *You must learn to let others share with you in that which you are doing, and honor and credit will be reflected upon you for so doing.*

Marshal Foch, the great commander, said to me a short time ago, when I congratulated him upon the wonderful work of the war: "This great military staff is like an orchestra, and each one fills his place. Each is equally important in the functioning of the whole. If the baton is in my hands it is merely a matter of chance, but we shall see to it that each man in this staff gets recognition for that which is due." *You never heard a great man say: "I did this"* or *"I will do that."*

In the management of my great enterprises I have yet to ever find fault with any man. *If a man is of the character that you must find fault with him to get the best out of him he is not a man to be desired in an organization.* Show me the man that will do his best under approval and I will show you the man that has within him the elements for successful going ahead.

Boys, there are other things in life than the mere work. *I believe an appreciation of the finer things in life,* the learning to know the *beauties of literature and art and music, will help any man in his career.* A man to carry on a successful business must have imagination. *He must see things as in a vision, a dream of the whole thing. You can cultivate this faculty only by an appreciation of the finer things in life.* No active business life, whether it is manufacturing or something else, can prevent you from enjoying the beauties of life. These finer things will contribute to your success.

Make Friends

Be friends with everybody. When you have friends you will know there is somebody who will stand by you. You know the old saying that if you have a single enemy you will find him everywhere. It doesn't pay to make enemies. Lead the life that will make you kindly and friendly to every one about you, and you will be surprised at what a happy life you will live.

I said coming down in the carriage, "What would I not give to be your age again!" I have not a single regret in life. The hardships that have come to me in life have but made me the keener enjoyer of the good things in life. I tell a story of a German workman I had years ago, and a saying of his that I adopted as a motto in life. We were having labor difficulties at the mill. He was a loyal fellow. The workmen picked him up and threw him into the river one day because he had reported for work. He came into my office all covered with mud and water, to tell me what had happened. I asked him what he said. He said, "I yust laughed." That's the thing to do—"yust laugh."

I am going to tell you a little more—I am not lecturing tonight, but just talking as if you were in my drawing room. I would just like to say to you what I feel just as if you were my own sons.

I want to tell you a little more about this man Grace, because one often sees the points in a successful life best by analyzing a single individual. I told you of his great faculty of making good, no matter in what position he was placed. This boy went on and on. Above all, he worked hard with that brain of his which had been trained in the university to think and concentrate upon the subject that he was thinking about until he had reached a satisfactory conclusion. Now, that is the great point, to concentrate and think upon the problem in mind until you have reached a satisfactory conclusion in your own mind, and then finally go ahead. If you have made a mistake, all right. *Never find fault with a man because he has made a mistake. It is only a fool that makes the same mistake the second time.* I tell a story of my own experience with Mr. Carnegie as showing what this might mean.

Don't Make Same Mistake Twice

As chief engineer of the works I had just built a converting mill. I went to him and said to him: "If you will give me the money to build this mill I can save 50 cents a ton." Of course he provided the money, and the mill was built. He came out to see it. I walked around with him. He saw the look of disappointment in my face and said: "Charlie, there is something wrong here. What is it?" I said: "It is exactly what I told you, and it is better than I told you. We save more than I said. But I don't mind saying that if I had to do the whole thing over again I would do it so and so. I made a mistake in that particular." He said: "Can you change it?" I said: "No." He said: "What does it mean?" I said: "It means tearing it down and doing it over again." He said: "Go ahead and do it. Don't make the same mistake a second time." *Do you suppose if he had been a fault-finding man I ever would have told him? Not at all. He brought out the best within me.* When that mill was torn down and a second one took its place it was as great a success over the first as the first had been over the old one.

Mr. Carnegie had my confidence, and I had his confidence. He believed in everything I had told him. If I had told him something that was wrong and not admitted my mistake he would never have allowed me to progress, and his works and his great establishment would never have progressed as they did.

Managers Are Business Partners

Now, in my own establishment you will be interested to know something about how we do things. You boys will all, of course, have to start to work upon a salary. But the quicker you get out of working for a salary the better for all concerned. In our works at Bethlehem and San Francisco and all over the United States I adopted this system: *I pay the managers of our works practically no salary. I make them partners in the business, only I don't let them share in the efforts of any other men.* For example, if a man is a manager of a blast furnace department he makes profit out of the successful conduct of his department, but I don't allow him to share in the prosperity of some other able man in some other department of the establishment. I give him a percentage of what he saves or makes in the department immediately under his own control and management. For example, if it takes a dollar a ton to make pig iron, and it takes him a dollar a ton to make pig iron, I say to him:

"Well, you are no better than the average manager over the country. Therefore you are entitled to only the usual wages. But if you can make pig iron at 90 cents a ton you are entitled to share with me in a large part of the profits. And if you make it for 40 or 50 cents a ton you share to a very large degree."

Therefore, I don't care how much a man earns. The more he earns the better I like him. And I pay in what I call bonuses to the various superintendents and managers of the different establishments more money for their suc-

cessful management than I pay the stockholders of the concern in dividends. And it will surprise you to know the great sums of money that some of these men make. I would be afraid to tell you for fear of discouraging you in your start in life. But I don't mind saying that forty, fifty, sixty, a hundred thousand dollars a year for these men is not infrequent. And in the case of men like Mr. Grace, well, many, many times that.

It is a matter of common knowledge and it is a matter that has been published. And I am grad to tell you that in the carrying out of this principle Mr. Grace has earned considerably more than $1,000,000 a year.

Now, I do the same with the working people. I say that a good workman is entitled to more pay than a poor workman. And, therefore, wherever it is possible *we have our workmen paid for the amount of work they do.* I know that is contrary to the general rules of trade unionism, but it is the proper economic basis that a man shall be paid for the work he does and proportionately to the work that he does. And so I carry this principle through every establishment I have. The Bethlehem business is now the second largest business in the United States. It was exceeded only by the Steel Corporation last year. Other than that, it was the largest business in the United States, and I give it no more thought or no more attention and not as much as I have to my coming to be a guest of you boys here this evening.

In writing the organization for our establishment I say *the president shall have no duties, and shall keep his mind free to survey and direct the whole affair, so as to have it go in harmony.* I am so confident of the organization we have got that *I find that they do better when the old man is away. I have never yet seen a record broken in any department when I was at all attending to business.* It has always been broken when I have been away, when a man has been put upon his own mettle to show what he can do. But I am no boss. I let younger men run these great establishments, notwithstanding the fact that I own the greater part of them. The younger fellows get to learn that if they are successful they can run the old man around. After all, there is nothing so scarce in the world as competent and successful men in the management of a business. There is nothing we are so constantly looking for as that.

Influence a Poor Start in Life

Now, to be more practical: A lot of you fellows are going out into life. Let me give you a bit of advice. *If you have any influence in the world to get you a start in life, don't use it.* The worst thing than can happen to a man is to start life with influence. He has got to do twice as well as the fellow that starts upon his own merits, because, after all, it depends on the general opinion of all those around you as to how competent and successful you are, and when everybody says that you do well because of the influence back of you, then you have got to do twice as well as otherwise. If you are going into any manufacturing establishment, don't go there by reason of any influence you may have. Start upon your own merits, and start in some lowly position, no matter what it is. Be a laborer, if you will. I don't know but that is the best way to start.

A man educated in a great university like Princeton is ten times the man who has not been educated in a university, if he will only learn that education in a university is not different from education in a workshop. You cannot be aristocrats unless you earn the right to aristocracy. And *the aristocracy in the future is not one of wealth or university education, but the aristocracy of the men who have done something for themselves and their fellow-men.* And that is what will make the real man. That is the lesson that you have got to learn, and that is the lesson that so many of our college boys don't learn. They go into a great industrial or other establishment, and they imagine because they have a diploma from Princeton or Lehigh or Lafayette or some other college or university that they are in a different plane from the other men. Boys, unless you get that out of your heads you are going to learn the sorriest lesson you ever learned, because it won't succeed.

This great war has taught us many things. The one thing it has taught us above everything else is that the true life is the life of modern democracy and simplicity, that it is not one of show or of extravagance; that we are men because we are men and because we have the true instincts of men, and we are not men because we are rich or because we occupy a high social position or because we have influence. Now, that's the thing that boys from universities have got to learn. And they are learning it fast, and this war has taught us more than anything else that it is now the fashion, and it is in the most liberal sense the fashion, to be simple and to be democratic; that the real man is the man that will live in that way and derive more genuine pleasure and satisfaction in the doing of it than he imagined before.

Opinions on Assets Differ

Now, boys, I have a great house in New York. I have a great country estate. About the only pleasure I get out of it is the fact that I have to pay its taxes and have enough money in bank to do it with. I don't own the estate and I don't own the house. They own me. My secretary made me up one day a list of my assets and liabilities. I am not going to tell you what they were. But he had this great estate and house on the side of my personal assets. I said: "You are wrong; they are not an asset, they are a liability. Put them on the other side." So it is, boys.

As I grow to be older I find that I want to have simpler things about me, the truest of old friends. And, boys, if you could know the joy of the long association and companionship with men such as I have known you would realize that you yet are to have such a compensation for old age as you have no idea of and you are to enjoy the truest thrills that come to the life of any man.

Now, boys, I have talked to you a long time. I have talked because I love to talk to you, and I see how interested you look. Just one thing more. Go at your work. You may not find yourself the first year. You may start at work that you think will not be agreeable to you. Do not hesitate to change. If you find that it is not according to your tastes and ultimate ambitions, then change and go into something that is more pleasant. *No man can be successful at work if he doesn't find the work he has to do pleasant.* No man can ever do a thing well that he is not interested in. You boys will find in your classes that you do best in the things you like to do. When you start in life if you find you are wrongly placed don't hesitate to change, but don't change because troubles come up and difficulties arise. You must meet and overcome and conquer them. And in meeting and overcoming and conquering them you will make yourself stronger for the future.

Then go on and select your work. Let us suppose you become a craneman. Suppose you become a clerk in a lawyer's office. Give the best that is in you. Let nothing stand in the way of your going on.

"Watch That Young Man!"

I am going to tell you the story of a man that came to see me in New York, Charles W. Baker, the president of the American Zinc Co., a very good friend of mine. Thirty years ago as manager of the Homestead Mills I went to Cleveland to see some plates that were being made. I got there at 6 o'clock in the morning. I had telegraphed the superintendent that I would be there that morning. He was in the office. But, being early in the morning, I went right out to the works, thinking I might see something out there that would guide me in the making of these plates. When I got to the works I found this young man Baker, a stenographer and employee of the office, who had not been directed to go out there, but who thought when the works manager arrived out there he might want somebody to be on hand to meet him, and he was there, the only one that was there. And when I went back I said to the superintendent: "Watch that young man. When you have a chance give him a chance, because he is in earnest." It wasn't long before Baker got to be his assistant. Later he was agent. Later I made him the general agent of the

whole Carnegie company. Later I made him a partner. Today he is many times a millionaire and the president of the great American Zinc Co. in New York. That is the story. That one little thing helped him forward.

But don't believe, boys, that you can make opportunities for things like this. That will always fail. They must come naturally, and the only way that they can come naturally is to give your whole heart, give your whole soul, give your every thought, give your every act to the accomplishment of what you are going to undertake. *If you will but make up your mind and determination to go through with what you undertake, you will have done more toward a successful life than you will have done in graduating from this great university,* and you will do that which will bring you more genuine pleasure, satisfaction and comfort in life than anything else you will ever do.

Determination, loyalty, integrity and stick-to-it-iveness to the bitter end, happiness and prosperity to you all! May you have the same joys of life that I have had. I could wish nobody anything greater, not because of money made, but because I am surrounded by appreciative friends, because I am the guest of you boys here tonight.

A Case of Mistaken Identity

Many years ago I was coming home from a mill of which I was manager—and if there is anybody who is well known about the town it is the manager of the mill. I was met at the station by a colored boy with a buggy. As we drove down the street we passed a workman's wife and a little girl. The workman's wife said to the child: "Look, dear, that is Mr. Schwab in the buggy." The little girl quickly said: "Which one, mamma?"

I tell another story that may amuse you boys. Many people when I make a talk like this introduce me with a lot of flattering things that are not true. I tell this story to bring myself to a proper frame of mind. I met a soldier over in Europe. He was decorated with medals from one shoulder to the other. I said: "There is really a distinguished man." So I go up and say to the fellow: "Do you mind telling me why you have received all these wonderful medals and things?" He said: "I will tell you with great pleasure. *The first large medal you see on my left, I got that by mistake. And I have all the others because I got that one first.*"

Boys, I am sure you have never had any one make you such a rambling, such a disjointed speech. I hope your professor of English is not here. A short time ago in Europe I met a lot of foreigners. I had to make a little speech, and I did it and then turned to my friend, Mr. Vickers: "You speak all these languages. Interpret this to all the people." He turned to the others and said: "I have been asked to interpret Mr. Schwab's speech into the various languages, and take pleasure in doing so. I will first render it into English."

I don't know just what I ought to say to you boys tonight. What would I not give to be one of you, as I said before? What would I not give to have the pleasure of coming to this splendid old hall with the traditions that surround the place, with your distinguished president here at the head of this great university! As is the leader so will be the boys. If any word of mine may give you fresh courage or confidence, then I am a thousandfold repaid for the effort—and I assure you it has not been really an effort—in saying these words to you.

Good cheer, success, loyalty, friendship, integrity, good-fellowship, honesty—and a happy life to all of you!

Minnesota Studies Stream Pollution

With a view to establishing standards of stream pollution in Minnesota the State Board of Health has begun an investigation in co-operation with the U. S. Public Health Service on the present condition of the Mississippi River within the state. This is being done as a basis for an intensive survey later on which will provide a basis for intelligent legislation restricting excessive pollution of all streams.

Letters to the Editor

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Advertising Engineering Service as Commodity

Sir—In his letter appearing in the issue of March 18, p. 589, Horace M. Holmes suggests that the remedy for conditions prevailing among engineers will be found in intensive advertising on a large scale. Just as by this method sales of a particular brand of merchandise can be increased largely, so can a demand for engineering service be created, says Mr. Holmes.

If engineering services were all under central control, or handled by a few firms, who were thus in a position to charge for such, according to the ability of the engineers whose skill was supplied, or in accordance with the type of service rendered to the clients, it would be possible to view the situation more in the light of a mercantile proposition. There would be employment for no more engineers than such firms would require for the business they could secure through advertising or other methods. It would be useless for colleges and training schools to create an oversupply, for there would be no demand for the graduates. Under such conditions it is easily conceivable that engineering service advertised as other commodities have been exploited could be brought more pointedly before the public, and a higher price could be obtained, because of standardization and through the control of the supply as related to the demand.

However, no such status obtains or is likely to be created. Except where legislation for licensing the engineer has been enacted, there is nothing to prevent anyone from claiming proficiency in the art. There is no curb to the addition of new recruits to the ranks—demand and supply cause no delicate reaction upon each other. Without a strict organization there can therefore be nothing like a predetermined system of rates for compensation, which would be substantially the same in all parts of the country. Each engineer is in keen competition with his fellows and the employer takes advantage of this situation, especially when, as at present, there is decidedly no dearth of engineers.

The mere accomplishment of national advertising setting forth the excellence of engineering as an art would have no appreciable tendency to create a demand for good roads or adequate water supplies merely because the public had been informed that engineers know how to design and build such improvements. A local campaign instituted to stimulate public interest in a proposed improvement, a campaign financed by engineers in order to secure employment for them, would be more to the point, but this is a different proposition entirely.

A glance through the "Positions Wanted" columns in *Engineering News-Record* will show the wide divergence of opinion as to estimates of value which engineers place upon their services. Some with from 8½ to 19 years of experience ask $300 per month; others with from 10 to 20 years require $333 per month; still others state that salary is no object. These and other discrepancies, together with the fact that engineering service is now so highly specialized, indicate the

impractical side of attempting to treat it as an article of commerce. Although the advertising would educate the public, just as the A. A. E. is doing in its publicity work, the beneficial effects would not be proportional to the great cost involved, without complete and effective organization among engineers, without a weeding out of the unfit, just as the California raisin grower, mentioned by Mr. Holmes, rejects the culls from his product, and without the establishment of such relationship as would insure only a reasonable supply of service available to meet the demand. Even though such conditions were entirely desirable, we are as yet a long way off from their attainment.

Philadelphia, Pa. P. M. FOGG.

[Mr. Fogg forgets that there are literally hundreds of engineering positions held by men who are not members of the profession. There are county engineers and state engineers in all too many parts of the country who hold their positions because of political election thereto. The qualifications are usually restricted to citizenship and residence. Advertising will wake up the general public to the point of requiring engineers to fill engineering positions. The doctors have the public sufficiently well educated so that one of their number is always and without question chosen as the head of a hospital. Inevitably the law of supply and demand will work as it is working just at present. What else than that induces the corporations to pay $100 or more per month for recent graduates and has broken the former $125 dead-line in the railroads? The world needs more of its work done by engineers, not for the sake of the engineer, but because they will better serve the world's requirements.—EDITOR.]

Designing Columns for Bending Moment

Sir—In your issue of March 18, Mr. H. L. Bowman gives a method of designing members of a structure subject to direct load and bending. This method is not new, but it has been very sadly neglected by writers. W. F. Gronan showed it to me more than 25 years ago, and I have used it many times. The quantity "*Md* over *r* square" or, as Mr. Bowman has it, "*Mc* over *r* square" may be called an equivalent direct load, to be added to the direct tension or compresison of the tentatively designed member in order to adjust the area to suit the unit stress allowed.

Engineering science is much better served by emphasis on simple rules of design such as this than by reams of high theory that only the elect can follow.

Pittsburgh, Pa. EDWARD GODFREY.

"Professional Plagiarism"

Sir—Professor McDonald's article "Professional Plagiarism" in your issue of March 4, p. 477, tells a long story in a few lines. Cases of plagiarism ranging from bold piracy to unconscious imitation are fairly numerous. Yet the frequency of their occurrence makes them none the less objectionable. Of all authors, the author of technical books probably receives the least reward for the amount of toil and time he puts in, and he surely is entitled to all the credit due him for new ideas he develops. Acknowledgement of the source is the least reward a writer can give to the originator of a new idea.

A striking case of apparent imitation without acknowledgement of source has recently come to my attention. In his latest book "Structural Drafting and the Design of Details," Professor Carlton Thomas Bishop publishes a series of diagrams headed "Graphic Resultants." With but few and relatively unimportant variations these diagrams are exact reproductions of those for the "Graphic Solution of a Right Triangle," copyrighted in 1912 and 1914 by Constantine K. Smoley, and printed in his well-known book, "Smoley's Tables." As a structural and concrete man, I had numerous occasions to use those diagrams and have always admired the simple and yet clever idea embodied in them.

On the other hand, there is much to be said in praise of the integrity and fairness exhibited by many authors of engineering books, some of which also abound in original ideas. "Structural Detailing and Elementary Design," by Charles D. Conklin, to my mind, may serve as a typical example of fairness, lucidity and originality in presentation of the same subject of structural drafting. Professor Bishop apparently drew a good deal of inspiration from that book.

Scranton, Pa. SAMUEL BAKER.

Sir—Commenting on my article on plagiarism (March 4), Edward Campbell suggests (March 18) that, since I cited Tartaglia's cubic equation as an historic example of plagiarism, I should be careful in my accusations. Mr. Campbell explains that I obtained my information about happenings in the 16th century from a book on the history of mathematics and that I did not acknowledge the source—intimating that such procedure is very close to plagiarism.

Obviously we obtained our knowledge of history from books, and anyone citing an historical fact is indebted to books. The rivalry between Tartaglia and Cardan, however, is well known to students of the history of science (as I intimated in my article), and there would have been little point in mentioning any of the dozen references to such books that I might have mentioned, especially as I named Ball's history of mathematics in the same paragraph.

I tried to make clear in the article that a judgment on plagiarism may be difficult to arrive at, and that a sense of proportion is necessary to decide whether or not a writer has plagiarized. What I especially urged was the development among engineers of this sense of proportion. P. B. MCDONALD.

Assistant Professor of English, College of Engineering, New York University.

New York.

Engineer's and Client's Rights in Tracings

Sir—I should like to have your opinion, and that of your readers as to the ownership of tracings under the following conditions.

The county commissioners, desiring to build a new bridge, and having no salaried county engineer, turned the engineering work over to an engineer in private practice. The fee was to be a percentage of the cost of the work. The engineer prepared plans, specifications and estimate of cost, and the commissioners advertised and let the contract, using blueprints furnished by the engineer. Before the bridge was completed a difference of opinion arose between the engineer and the commissioners over another matter, and the engineer in order to "get back" at the commissioners refused either

to furnish or sell additional blueprints to them or to turn the tracings over to them. As he had been paid in full for his work, the commissioners had no means of compelling him to accede to their wishes unless they took the matter into court, which they did not desire to do.

Is the engineer justified in his stand? If more prints were needed to complete the work, could he claim that he had already furnished a sufficient number, and that the deficiency was due to carelessness on the part of the county officials? Are the plans his property or that of the county? Would it make any difference if he had been paid on a different basis? These are questions which should interest many engineers, and I believe a full discussion of the matter would be helpful to many of them.

"ENGINEER."

Errors of Approximate Rules for I-Beam Capacities

Sir—Two letters in your issue of Aug. 21, 1919, p. 388, discussed the subject of strength of I-beams. The authors, G. S. Burrell and W. H. Cullers, gave approximate methods for determining the strength quickly. These methods as stated are, to put it mildly, misleading, not to say dangerous. The tabulation below shows that there are a few cases where they may be applied, but these are only in some of the lighter sections. Outside of this range the variation from the correct figures is marked.

Elyria, Ohio. EDGAR PIERCY.

TWO APPROXIMATE METHODS FOR STRENGTH OF I-BEAMS COMPARED WITH CORRECT FIGURES

	Method of G. S. Burrell				Method of W. H. Cullers	
Depth of Beam, In.	Section Modulus G. S. Burrell, In.³	Tabular Section Modulus, In.³	Weight per Ft., Lb.	Span, Ft.	Safe Load W. H. Cullers, Lb.	Safe Load, Actual Lb.
24	240.0	198.4	100	24	100,000	88,200
24	192.0	174.0	80	24	80,000	77,300
20	200.0	165.6	100	20	100,000	88,300
20	130.0	117.0	65	20	65,000	62,400
18	126.0	102.4	70	18	70,000	60,700
18	99.0	88.4	55	18	55,000	52,400
15	150.0	120.1	100	15	100,000	85,400
15	63.0	58.9	42	15	42,000	41,900
12	66.0	53.5	55	12	55,000	47,500
12	37.8	36.0	31.5	12	31,500	32,000
10	40.0	31.7	40	10	40,000	33,800
10	25.0	24.4	25	10	25,000	26,200
9	31.5	24.8	35	9	35,000	29,400
9	18.9	18.9	21	9	21,000	22,400
8	20.4	17.1	25.5	8	25,500	22,800
8	14.4	14.2	18	8	18,000	18,900
7	14.0	12.1	20	7	20,000	18,400
7	10.5	10.4	15	7	15,000	15,800
6	10.35	8.7	17.25	6	17,250	15,500
6	7.35	7.3	12.25	6	12,250	13,000
5	7.375	6.1	14.75	5	14,750	13,000
5	4.875	4.8	9.75	5	9,750	10,200

Why Vote "No" on External Questions of the A. S. C. E. Ballot

Sir—Let us take the time to think over the questionnaire sent out by the American Society of Civil Engineers. The members should realize that they have until April 14 to file their answers, and that new blanks can be obtained now if they have lost the ones originally sent out. Replies should be sent in by every member, after careful consideration of each question separately.

Consider for a moment that we have before us all of the reports submitted by the various committees, the current discussions, the records of the work of the Engineering Council, the reports of conferences with the Founder Societies and the data regarding the American Association of Engineers. What is the large meaning of the accumulation? To me it means that our Society, among others, with its years of merited distinction in the advancement of science has, of late, found itself inflexible to the call of the times for social betterment and civic activity. We have criticised and have knocked and have finally succeeded in opening wide the whole subject of our reason for being. It also means that during the time that has been occupied in this process a new organization has sprung up having for its purpose the very thing that now demands our attention. In a Questionnaire of this length it is to be regretted that there should have been no direct recognition of the existence and activities of the American Association of Engineers, a Society which already outnumbers ours and which will doubtless outnumber, before long, the combined membership of the Founder Societies and which has for its object "to raise the standards of ethics of the engineering profession and to promote the economic and social welfare of engineers." While I am a member of that Society I consider it eminently fitted to take up problems of the kind proposed to Questions 1 and 3.

There is no technical society of a higher recognized standing than that of the American Society of Civil Engineers. It can maintain that standing by continued and systematized effort in the advancement of engineering science, meanwhile safeguarding its membership. To a great extent its members represent the employer and have individually in their charge the determination of salaries and working conditions for a large part of the engineering world. As a Society we now have, without constitutional amendment, the privilege of expressing our opinion and lending our strength wherever and whenever we see fit to do so.

Can we not pause long enough to realize that our real progress just now must be with regard to internal efforts rather than external? Doubtless we are going to give greater influence to the local sections thus securing better co-operation of the entire membership and greater interest. We are going to have new methods of representative nominations, and I believe that the directing officers so chosen can build far better on old foundations than they can on revolutionary changes in the constitution affecting the object of the Society. The object, as now expressed in the constitution, is "The advancement of engineering knowledge and practice, and the maintenance of a high professional standard among its members." When we cast a vote let the attainment of that object be the criterion.

I, therefore, expect to vote "no" on Questions 1 and 3; that is, I do not believe that the American Society of Civil Engineers should adopt the principles as a society of becoming an active national force in economic affairs, and I am of the opinion that another organization in addition to all of those already at work would tend to disperse our efforts.

Just what is the most effective way to secure an immediate and complete co-operation with other engineering and allied associations referred to in Question 2? *Why not develop a plan whereby every member of every Founder Society, unless they personally object, becomes a member of the American Association of Engineers?* Let that body be universal in the engineering field, becoming more powerful in civil and economic affairs than any committee or conference could be. Our individual strength will still have its influence in that

body. The fact that A. S. C. E. would have only a small minority influence in any organization such as proposed by Question No. 3 has already been brought out before the Society. The plan above outlined appears to overcome many of the objections which have been brought up. We would have every advantage of co-operation on external problems, and of independence in the handling of our own affairs and the attainment of our own objects.

There is rightly a marked difference in the qualifications to the two societies, which permits all who look upon engineering as their life work to join the A. A. E. while responsible technical experience is necessary for membership in the A. S. C. E. Membership in the A. A. E. eventually will be a stepping stone to membership in the higher technical bodies.

I believe that a uniform annual dues of $25 of which say $5 would go to the A. A. E. would be feasible and would make possible the greatest accomplishment by both societies. Membership in local sections of the A. S. C. E. should also be covered by the annual dues paid the present society.

This may not be a new suggestion, but if not it has escaped my attention and it appears to offer a reasonable solution. I would be pleased to hear from the members with the view of submitting the question to the secretary of the A. S. C. E. W. E. BELCHER.

New York City.

Dividing a Trapezoid Into Equal Parts

Sir—The letter on division of a trapezoid into strips of equal area given by R. B. McWhorter in your issue of Jan. 22, 1920, p. 194, would have been more complete if he had incorporated a general formula for dividing the trapezoid into any number of strips. Using Mr. McWhorter's notation, the following general formula may be written:

$$P_{x+1} = \sqrt{\frac{(n-x)\ P_1^2 + x\ P_{n+1}^2}{n}}$$

Where P_{x+1} is the length of the farther side of the x strip. This formula will be found applicable to the example given by him. H. B. PERRY.

New London, Conn.

[The same formula is sent by another reader, who also gives a formula for the distances to the successive division lines:]

It is believed that an expression giving the distance from the initial side of the trapezoid to any division line will often be found better than that giving the length of the division line. Calling the distance to the far side of the x the strip l_x, the expression is

$$l_x = \frac{L}{P_1 - P_{n+1}} \left[P_1 - \sqrt{\frac{(n-x)\,P_1^2 + x\,P_{n+1}^2}{n}} \right]$$

Chicago, Ill. H. H. FRENZEL.

Dr. Waddell on Bridge Construction

Sir—On page 564 of your issue of March 18 I note a "unique" scheme in cantilever construction adopted last year for a small bridge built in the Philippines. In 1884 I saw the same device in a Japanese bridge, located, if I remember correctly, in the city of Osaka. Again, of late years in several as-yet-tentative designs I have used the same idea of combining cantilevers and lift spans (both vertical-lift and bascule) for long-span bridges.

In re the discussion by Mr. Fleming *et al* of a history of engineering, I would point out that as long ago as 1903 I made a formal suggestion to the Society for the Promotion of Engineering Education that it undertake the preparation of such a work, the task of writing it to be divided among the members. The idea was well received, but nothing was done. A little later Dean Anson Marston of Iowa State College started writing a history of engineering, but his progress on it has been slow. However, I understood that he is still working on the MS.

In reference to your editorial of Feb. 12, 1920, speaking of the special importance likely to be given to economy in bridge construction in the future, I would state that, soon after the issue of "Bridge Engineering" in the summer of 1916, I started an extensive series of investigations on bridge economics with the intention of solving the last then-unsolved major economic problem in bridgework, of which I listed eight all told. Seven of these have since been solved, the eighth being still under investigation; and three having already been published in the proceedings of two engineering societies.

Based upon the results of this series of studies and the numerous other investigations on economics in bridge designing that I have made during the last three or four decades, the results of most of which have been recorded in my technical books and papers, I am now preparing, as a sequel to "Bridge Engineering," an exhaustive treatise entitled "Economics of Bridgework." As the MS. thereof is three-quarters finished, I ought to finish the task within a twelvemonth, unless something unforeseen occurs to prevent. It is to be my final contribution in book form to engineering literature; and, consequently, I am trying to make it as complete as possible. J. A. L. WADDELL,

New York City. Consulting Engineer.

Snow Conditions in Toronto's Streets

Sir—New York readers, in view of their recent experience with snow in the streets, may be interested in conditions in Canada. We people who live in the northern cities are accustomed to having 6 to 12 in. of snow, and with the exception of a couple of hours of disorganization, very rarely is the transportation system put out of business. The method of handling the snow generally consists of street sweepers and plows operated by the street railways, and on the main streets the excess snow is carted away.

At the present time in Toronto on the side streets there is easily from 9 to 12 in. of packed snow, which is nearly solid ice.

The street railway tracks are 6 in. or more below the ice level of the streets. In fact this level is maintained by the steps of the street cars scraping the surface of the ice. While it is rather rough going at times on some of the streets, motor traffic is continued throughout the entire winter and we hear very little complaint about snow removal, perhaps because the people do not expect it. The main effort of the city authorities is to keep the gutters and catch basins open so that in case of sudden thaw the water will have a chance to get away. The only machinery used is horse-drawn road scrapers, occasionally plows and street sweepers.

E. M. PROCTOR,
The E. A. James Co., Ltd.,
Toronto. Consulting Engineers.

HINTS FOR THE CONTRACTOR

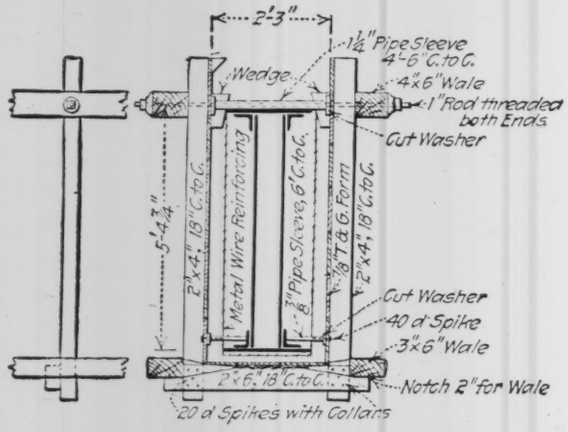
DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Self-Sustaining Forms for Concrete Casing of Steel Girders

BY C. A. PECK
The H. Wales Lines Co., Winnipaugh, Conn.

FOR the incasing in concrete of the main girders of several 40-ft. and one 60-ft. plate-girder steel bridges the selfsustaining forms shown in the accompanying drawing have proved satisfactory.

According to the design the steel was to have 4 in. of concrete all around with the exception of the top, which was to be brought up to floor level. Sides and bottoms of the forms were built in 20-ft. panels with 2 x 6-in. crossbars at the bottom offset enough so that they would fit snugly against 2 x 4-in. vertical ribs. These were spiked together as shown and kept at a proper distance away from the girder by ⅜-in. pipe sleeves held in place by 40-d. spikes driven through the sheathing. Heavy form wire twisted around the bottom wales held the lower part of the form rigid. At the top a 1¼-in. pipe sleeve with a 1-in. rod through going wall and every third stud acted as spreader and tie and also served to carry the form on the girder. Holes for the rods were carefully spotted to insure keeping the bottom of the form level, and cut washers were used to keep the pipes away from the forms. These were dug



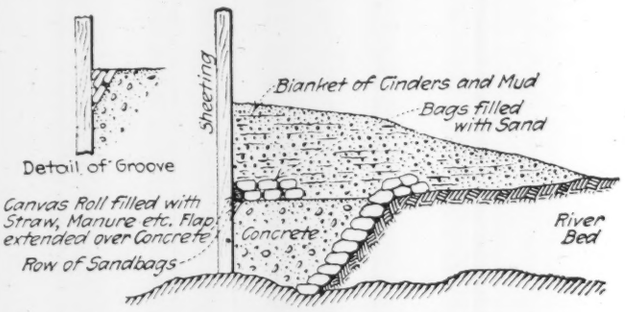
DETAIL OF SELF-SUSTAINING FORMS USED IN INCASING PLATE GIRDERS WITH CONCRETE

out when the forms were stripped and the holes grouted. Wooden wedges, which were removed when concrete was up even with the top flange of the girder, were used to line the top of the forms.

In setting, the side forms were first swung into place and held by the 1-in. rods. The top wales were then put on and bolted and next the ⅜-in. pipes were placed. Then the bottom panel was hauled up and spiked to the studs as shown, nail collars being used to facilitate stripping, for the forms were reused. The last operation was driving the wedges between the top flange and the side form to bring it up to the required line. Work on the under side of the forms was done from a scaffold suspended from the top wales.

Concrete Seals Cofferdams on Rough-Rock Bottom

Cofferdams consisting of timber frames enveloped with steel channel and I-beam sheeting for the Key Bridge across the Potomac River at Washington, D. C., are being successfully sealed to a rough-rock bottom by the construction indicated by the accompanying sketch. The frames were sunk into dredged pits and then the sheeting was driven to contact with the rock. The sides of the pit, which was larger than the cofferdam, were then slope-paved with bags filled with sand and the trench between pit sides and sheeting, all



CONCRETE SEAL FOR KEY BRIDGE COFFERDAM

around the structure, was cleaned to rock by means of a sand ejector. Triangular forms bearing against the sheeting were next suspended from the sheeting at the level of the top of the trench, which was then filled with concrete by means of a tremie. Removal of the forms left a V-shaped groove in the concrete and next to the sheeting, and into this groove were packed sand bags. On top of the sand bags and against the sheeting were placed rolls of straw and manure encased in canvas and with the canvas flap spread back over the surface of the concrete and flap and roll weighted down with bags of sand. The object of this pliable wedge was to fill in any space resulting from the inward give of the sheeting due to outside pressure when the cofferdam was pumped out. Finally after the seal had been proven intact by laying dry the cofferdam it was covered with mud and cinders as indicated by the sketch. As soon as the dams were dewatered an inner seal of concrete was deposited against the sheeting. It has been found practicable to pull the steel sheeting and in other respects the concrete seal has operated satisfactorily. The Key Bridge is being constructed by force account under the direction of Col. W. L. Fisk, Corps of Engineers, U. S. A. The data here given are taken from an article in *The Military Engineer* by John T. Talman, assistant engineer.

American Shipbuilding in 1919

According to the Bureau of Navigation, Department of Commerce, private American shipyards built 2,338 merchant vessels of 4,213,891 gross tons during 1919.

NEWS OF THE WEEK

New York, April 1, 1920

Construction Industries Complete Federation

Subjects Discussed at Chicago Convention Included Industrial Relations and Standardized Building Materials

Reorganization on more definite lines of local administration was completed at the annual convention in Chicago March 24-25, of the National Federation of Construction Industries. Prominent among the changes made were: A revision of association membership dues, the admission to suffrage of individual members, an increase in the number of directors and regional vice-presidents, the creation of an advisory board and a staff council and the development of district organizations. A financial budget was adopted which provides for the expenditure in 1920 of $100,000 for federation work.

The attendance was smaller than was anticipated. With an excellent program, speakers of national prominence often addressed an audience of less than a hundred delegates. A too great number of speakers crowded the program and several were compelled to curtail their remarks and pass hastily over important subjects. In the majority of cases, fortunately, the addresses passed over were prepared and can be published for future distribution.

Industrial Relations

In five years all jurisdictional disputes leading to strikes will be settled without a strike, was the prophecy of E. J. Russell, chairman, National Board of Jurisdictional Awards. The creation of this court of determination, he stated, had the complete support of organized labor and had already in its brief existence proved its efficiency by disputes satisfactorily adjudicated.

Governor Henry J. Allen of Kansas explained the new anti-strike legislation of that state, which developed out of the coal strike of last fall, as a court of justice for employer, workman and general public. This court held no brief for or against organized labor or capital. Its purpose was to establish absolute justice in any dispute between employer and employee and to enforce action to insure justice while protecting the general public during adjudication by making illegal and punishable a strike in any industry affecting the necessities of fuel, clothing and food. Kansas, he stated, was now a state without strikes. Disputes were being successfully adjudicated in all the industries within the jurisdiction of the court and already, in the industries outside of court jurisdiction, requests were

(*Continued on p. 690.*)

To Hold Immigration Conference

A national immigration conference will be held April 7 in New York City in the Engineering Societies Building, 29 West 39th Street. National leaders in American industry and finance will discuss the shortage of foreign-born labor and the loss of production due to unrest among the workers. Measures will be taken for united action to relieve this condition.

Invitations to attend this conference have been issued by The Inter-racial Council to more than a thousand of the directors of industrial concerns. All industrial executives are invited to be present. Further details may be secured by addressing Coleman du Pont, Chairman of the Board, The Inter-racial Council, 120 Broadway, New York City.

Board of Surveys and Maps To Have Advisory Board

Prof. E. B. Matthews, National Research Council, and M. O. Leighton, National Service committee representative of Engineering Council, have been authorized by the recently created Board of Surveys and Maps, to organize an advisory council to the board consisting of representatives of engineering, geographic and other organizations, which shall represent the public and the professions in the presentation and discussion of unofficial demands and needs in connection with the mapping work of the United States.

Ohio River Bridge To Be Rebuilt

Reconstruction of the Ohio River bridge of the Cincinnati Southern Ry. at Cincinnati, Ohio, is the latest project for the rebuilding of notable structures which have become inadequate for modern conditions of loading. This bridge was completed in 1877, or 43 years ago, its river spans and piers being designed by J. H. Linville and built by the Keystone Bridge Co. At the north or Ohio end are two truss spans of 300 ft., followed by a channel span of 519 ft., a swing span of 370 ft. and a 110-ft. truss span to the high ground of the Kentucky shore. Low ground on the Ohio side requires an approach with six truss spans of 113 ft. to 190 ft. There is a single track 106 ft. above low water level. The river piers were built in open cofferdams and carried down to rock. The bridge was described in *Engineering News* of Nov. 24, 1877, Jan. 15, 1881, and Feb. 20, 1902. Plans for erecting a new superstructure on the present piers were prepared some years ago and bids for the work are now being asked by Ralph Modjeski, consulting engineer.

Local Section Action on Questionnaire Ballot

Twenty Sections Recommend Favorable Vote — Nationals Approve Joint Conference Committee's Program

[*This communication was received too late to be printed with the other "Letters to the Editor" in this issue.*—EDITOR.]

Sir—At this time when there are in circulation words of caution and various other letters and communications containing general statements, unsupported by arguments of a constructive character, bearing upon the report of the Committee on Development of the American Society of Civil Engineers and the report of the Joint Conference Committee of the four Founder Societies, a few facts may be helpful to the members of the American Society of Civil Engineers in enabling them to reach a correct decision in voting upon the questionnaire.

The resolutions, adopted by the Annual Meeting of the American Society of Civil Engineers by a very large majority, included the following:

"Therefore, be it Resolved that the Sixty-seventh Annual Meeting of the American Society of Civil Engineers hereby approves the fundamental recommedations contained in the report of its Committee on Development."

At meetings of local groups of members of the American Society of Civil Engineers, at which were discussed:

(a) The report of the Committee on Development, Am. Soc. C. E.,

(b) The so-called "Alvord Report" by the Committee of the Board of Direction, Am. Soc. C. E.,

(c) "A Word of Caution" signed by 106 members of the American Society of Civil Engineers, and

(d) The questionnaire issued by the Board of Direction under the instructions of the Annual Meeting of the American Society of Civil Engineers,

it was voted, in all instances by an overwhelming majority and in nearly every instance unanimously, that it was the sense-of the meeting that the members of the society should vote YES on questions 1 to 3, inclusive, under A, External Relations, and YES on questions 1 to 6, inclusive, under B, Internal Relations, contained in the questionnaire, on which the members of the society are now voting. These local groups are:

Philadelphia	Cleveland	Spokane
Boston	Columbus	Duluth
Connecticut	Cincinnati	Colorado
Baltimore	Detroit	Seattle
District of Columbia	St. Louis	Portland,Ore.
	Texas	San Francisco
Pittsburgh	Iowa	So. California

(*Continued on p. 692.*)

Illinois Water Works Men Talk of Service and Treatment

The interlocking relations of the public, the public utility corporations and the public service commissions received a good share of attention at the annual meeting of the Illinois section of the American Water Works Association, held at the University of Illinois on March 25 and 26. Dow R. Gwinn (Terre Haute Water Co.) in discussing the high cost of money to public utilities pointed out that good service is as important to the public as is a reasonable rate for service, and that rates should be such as to permit the corporation to give adequate service. Public service commissions, however, have been inclined to aim only at low rates and to overlook the matter of service.

Present and pre-war reproduction cost of waterworks was the subject of a paper by L. R. Howson (Chicago), giving tabulated prices of material and labor for a term of years and showing that the present cost of plants complete is from 63 to 89 per cent above pre-war cost. Mr. Gwinn urged that valuations of plants should be based on these high prices, although some public service commissions refuse to consider this. The unsatisfactory operation of municipal water works plants under political control was noted by L. A. Fritze (Peoria) who advocated an Illinois law similar to one established recently in Iowa which takes the water department out of politics. Under this law the administration of the water department is comparable with that of a private company, being in the hands of a board of trustees appointed by the mayor for a term of years and the management being put in the hands of a competent waterworks man instead of one selected for political reasons.

An outline of the benefit of chemistry in the operation of waterworks plants, presented by Kenneth Holaday, chemical engineer for the Central Illinois Public Service Co., led to the remark that the company was to be congratulated on realizing the advantages of the application of chemistry to small as well as large plants. The value of bacterial tests was presented in a paper by M. F. Stein (Chicago). An outbreak of dysentery and typhoid at Bloomington, due to cross connection with an impure supply at the railway shops, was described by M. C. Sjoblom (State Board of Health); Dr. Edward Bartow (State Water Survey) called attention to the fact that most of such outbreaks in Illinois have been due to similar cross connections. Dr. Bartow also described an investigation as to odor and taste in water at Mt. Vernon, which traced the cause to organisms in the water at one of the reservoirs, and treatment with copper sulphate removed the trouble.

Location of leaks in water mains by telephone, water hammer and hydraulic gradient study was described by Prof. H. E. Babbitt, and some members spoke of trouble with apparatus for the first method. Development of a shallow ground water supply was explained by W. D. P. Warren (Decatur). Other subjects included stream pollution, by Langdon Pearse (Chicago Sanitary District); purification of sewage as protection for water supply, by D. P. Hommon (U. S. Public Health Service), and the purification of water and sewage, by W. J. Allen (North Shore Sanitary District). The officers for 1920 are as follows: President, F. C. Amsbary, manager of the Champaign & Urbana Water Co., Champaign, Ill.; vice-president, L. A. Fritze, Peoria, Ill.; secretary, G. C. Habermeyer, State Water Supply, Urbana, Ill.

Construction Industries

(*Concluded from p. 689.*)

frequent, by the agreement of both parties, that the court undertake a settlement.

Under the title of "Americanization" Frances A. Kellor, associate managing director, Inter-Racial Council, outlined the part that industry had to play in stabilizing industrial relations. The argument was in essentials that presented by Miss Kellor in *Engineering News-Record*, March 11, 1920, p. 517.

Transportation

Revolutionary improvement in railway service cannot be expected to follow the realease of the railways from government operation. The arrears in physical means for improved service and in morale and efficiency are too great to be paid up immediately. An improvement will come soon and will be more pronounced as the months pass and the managerial and financial machinery is adjusted to the provisions of the Esch-Cummings railroad bill. Means are being provided through the remodeled American Railway Association for a closer co-ordination between shipper and railway and, with the cooperation of the shippers, these means promise to relieve much of the trouble now existing. To these statements the three principal speakers A. G. Gutheim, American Railway Association; E. G. Sutton, business manager, National Association Sand and Gravel Producers, and Robert C. Wright, general traffic manager, Pennsylvania Railroad Co. agreed.

Standardization

Standardization in the construction industries was the business of one full session. E. S. Hall, speaking as a member of the American Institute of Architects, called upon the construction industries to curtail by standardization the varieties of building materials. He classified building as 25 per cent special and 75 per cent standard and stated that under competent designers the larger percentage could be standardized with vast savings in cost and no loss in beauty. The functions and the operations of the various organizations having the task of developing standards were outlined by S. W. Stratton, director, U. S. Bureau of Standards; C. L. Warwick, secretary-treasurer, American Society for Testing Materials; A. A. Stevenson, chairman American Engineering Standards Committee, and C. C. Adams, chairman division of engineering, National Research Council.

Administration

Under the new organization, the administration of the Federation will be by a president, and by vice-presidents and directors chosen equally from Federal districts corresponding to the Federal Reserve Districts. These officers will be assisted by an advisory board and a staff council. In the staff council composed of the specialist employees of the members will rest largely the initiative in developing constructive action in legislation, industrial relations, standardization, etc.

Ernest T. Trigg was re-elected president and the executive officers continue at Philadelphia, Pa., with John C. Frazee as executive secretary.

I. C. C. Designates A. A. E. Official Representative of Engineers

As a result of the representations of the American Association of Engineers before the Interstate Commerce Commission hearing on March 15 and 16 regarding the classification of professional engineers in railroad service with reference to representation on the Railroad Labor Board, provided by the Transportation Act, the commission has conceded the justness of the claims made by the association and has declared that professional engineers in railroad service below the grade of chief engineer, engineer of maintenance of way and division engineer, and "other engineers who are not vested with authority to employ, discipline or dismiss subordinates" are subordinate officials.

The commission has classified professional engineers as "engineers of mechanics." This class includes civil engineers, draftsmen and "other engineers of mechanics." The American Association of Engineers is designated as the official representative of engineers of mechanics, and in common with six other groups of employees (claim agents, foremen of mechanics, supervisors of signals, yardmasters, train dispatchers and storekeepers) has been made the basis of a fourth group of employees to make nominations for members of the Labor Board.

The credited representatives of these seven organizations and those of a few additional labor organizations not affiliated with the American Federation of Labor which have been placed in fourth class are to make nominations for appointment to the Labor Board. Such nominations must be transmitted direct to the President not later than March 29. It has not yet been decided whether or not the American Association of Engineers will make a separate nomination, or whether it will agree with one or more of the other organizations of subordinate officials on a joint nomination.

Road Classification Undertaken in England

An elaborate system of traffic census taking; a detailed form for determining expenditure and receipts from different classes of highways, and the sources from which various maintenance grants come; and a careful survey of engineer compensation, are the salient features noticed in the work of British road classification. A circular letter has recently been sent out by Sir Henry P. Maybury, Director General of Roads, to all local authorities informing them that the Ministry of Transport has decided upon the classification of roads within administrative counties of England and Wales.

As one means of determining the relative value of roads, a census of traffic is to be taken for sixteen hours a day—from 6 a.m. to 10 p.m.—on seven consecutive days; the road department to notify the highway authorities as to the time and place at which the census is to be taken. A list of traffic census points is to be submitted to the roads department. Such points on rural roads need average only one per 10 miles of road, and in urban districts are to be confined to roads which are continuations of roads carrying a substantial percentage of through traffic.

With a view to determining what the expense of Imperial grant should be for maintenance and construction, an elaborate analysis of receipts and expenditure is to be made, for the years ending March 1, 1914, and March 31, 1920. In the expenditure columns are to be given costs of scavenging, watering, repairs and maintenance of carriageways and footways, improvement of carriageways and footways, guide posts, direction posts, and milestones. Information is also required as to the total remuneration of county surveyors for the year ending March 31, 1920. Such information includes salary for all duties, allowances and extras. The seeking of such detailed information upon compensation is taken as an indication that the surveyor's financial status is to be materially bettered.

Disagree on Valuation Basis in Argument Before I. C. C.

Disagreement as to the basis of value to be used in building up a new rate structure, after Sept. 1 under the new railroad law, was indicated in arguments before the Interstate Commerce Commission in Washington, D. C., March 22-24, in respect to grouping in rate districts and methods of fixing temporary valuations. Shippers, state railroad commissioners, the railroad executives, the railroad security holders, and railroad employees were represented.

The use of the present property investment accounts of the railroads as a temporary basis of valuation was attacked by John E. Benton, general solicitor, National Association of Railway and Utilities Commissioners, who said that the accounts were undependable and should not be used in lieu of more exact data on physical value being collected by the Interstate Commerce Commission. However, where the Commission could not obtain more definite data for the present it would have to take the property investment accounts after checking them up, according to Mr. Benton. Shipping interests as well as representatives of the railroad executives and security owners favored the temporary use of property investment accounts as the basis of valuation pending a final report under the Valuation Act.

General sentiment was expressed favoring division of the country into the same three rate groups now existing, with the exception that a proposal was made by some of the southwestern carriers that a separate group in their territory be made.

Progress on Standard Water Meter Specifications

The committees on standard specifications for water meters appointed by the New England and the American Water Works associations have recently held two joint meetings. It is expected that a progress report including tentative specifications will be completed early enough to be printed and sent to the members of the two associations about June 1, giving ample time for consideration by the members before the Montreal meeting of the American Association in June and the September meeting of the New England Association. The basis of the committee work now in progress is specifications outlined by the meter manufacturers. Charles W. Sherman, of Metcalf & Eddy, 14 Beacon St., Boston, Mass., is chairman of the New England committee, and Caleb M. Saville, director and chief engineer of the Water Board of Hartford, Conn., is chairman of the New England committee.

Board of Zionist Engineers for Palestine Development

Plans for the immediate reconstruction needs and industrial development of Palestine will be worked out by a technical board of the Zionist Society of Engineers and Agriculturists, James H. Haines, secretary of the society, announced March 31, in making public the names of the directors of the board. The board will consist of Dr. L. C. Lowenstein, General Electric Co., to direct the establishment of public utilities; Dr. Ferdinand Sonneborn, L. Sonneborn Sons, Inc., to be in charge of industrial engineering; Lazarus White, president, Spencer, White & Prentis, Inc., to direct construction development, and Joseph A. Rosen, vice-president, Youroveta Home and Foreign Trade Co., to be in charge of agricultural development.

Drainage Association in Illinois

The Illinois Drainage and River Improvement Association was organized at the drainage conference held recently at the University of Illinois. There are to be 12 directors located in the principal river valleys, each being chairman of a local committee. The president is A. L. Maxwell, Lawrenceville, Ill.; vice-president, S. E. Prather, Springfield, Ill.; secretary, G. W. Pickels, University of Illinois, Urbana, Ill.

Utah Engineers Endorse Water Supply Bond Issue

Salt Lake City needs an additional water supply, and a bond issue of about $2,600,000 will be voted upon at the Spring election for the program. It is hoped to make available by storage and conduit all of the water flowing into the valley from City Creek, Emigration, Mill, Parleys and Big Cottonwood canyons. Rights will be secured in Little Cottonwood canyon.

The Utah Society of Engineers has indorsed the improvement program, and the aggressiveness with which the Society has undertaken to see that the vote is carried has "put the Society on the map," writes one of its members. The committee which investigated the program was headed by Richard R. Lyman, professor of civil engineering in the University of Utah until he became one of the twelve apostles of the Mormon Church, an honor held for the first time by an engineer. The Society arranged to have its report published in full in the Saturday night and Sunday morning papers.

Protest Against Classification of Railroad Engineers

L. K. Sherman, representing the American Association of Engineers, presented arguments at the recent hearing before the Interstate Commerce Commission at Washington, D. C., in favor of a separate grouping for subordinate technical engineers. He pointed out that there are 20,000 technical engineers in the employ of the railroads of the country and that only 5 per cent of that number come within the category of executives. He declared that no other class of employees of the railroads have a more trusted relationship with the companies than do the subordinate civil engineers, assistant engineers, architects, rodmen, chainmen, and draftsmen. His contention was that the chief engineer, the division engineer, and the engineer of maintenance of way are not subordinate engineers but that all other technical engineers are subordinate. Since this class of railway employees has not had the standing of officials nor has it had representation among the organization of employees, Mr. Sherman held that they have been neither fish, flesh, nor fowl, and as a result have not had the salary considerations to which they are entitled.

Move Made to Improve Status of Canadian Engineers

At its meeting held March 4 the Toronto branch of the Engineering Institute of Canada passed a resolution calling upon the parent body to request all branches to appoint committees to investigate and report on methods of improving the economic status of the engineer. The resolution follows:

"Whereas, By reason of inadequate compensation, salaried engineers are now working under exceptionally trying economic conditions, which in some cases amount to hardship; and

"Whereas, Many engineers in the Toronto district are convinced that these conditions can be ameliorated only by direct organized effort and that immediate remedial measures are imperative; and

"Whereas, The Engineering Institute of Canada must either promptly face the issue and grapple with it, or stand aside and permit newer and perhaps foreign associations to press the claims of the engineers of this country for economic consideration; therefore, be it

"Resolved, That this branch urge headquarters of the Institute to forthwith request all branches to appoint committees, of not less than five members, with power to add to their numbers to thoroughly investigate and report through the various branches to headquarters upon the structure and constitution of an organization designed to bring into operation direct and concerted effort toward the improvement of the economic status of engineers; and that if practicable headquarters defray the expenses of these committees in the matter of holding hearings and obtaining stenographic reports of evidence."

Am. Soc. C. E. Members Urged To Aid Patent Legislation

An appeal has been issued to the membership of the American Society of Civil Engineers, at the request of Engineering Council, to urge their respective senators to vote for the Nolan Bill, H.R. 11,984. The U. S. Patent Office has long been handicapped in its work, the appeal states, by the insufficient compensation of its employees. The bill introduced by the Hon. John I. Nolan, chairman of the patent committee, House of Representatives, proposes increasing the salaries of the employees and staff of the Patent Office, which have not been changed for many years, except by one raise of 10 per cent. The salaries of the principal examiners are increased by the bill from $2,750 to $3,900. It also authorizes the courts to assess general damages under certain conditions in infringement suits, and makes other changes. The bill has been passed by the House of Representatives and is now before the committee on patents in the Senate. Senator George W. Norris is chairman of the committee on patents.

Albany Engineers' Attitude on Am. Soc. C. E. Questionnaire

[*The following statement has been received from members of the American Society of Civil Engineers residing in Albany, N. Y., and vicinity.—Editor.*]

Notwithstanding the criticism of the management of the American Society of Civil Engineers, particularly with reference to welfare work, the undersigned believe that better and more prompt results in improving the welfare of the civil engineer can be obtained by reforming the existing society internally than to attempt the improvement of the welfare through a new organization as proposed.

The undersigned recommend "No" to Question No. 3 of questionnaire to be canvassed April 14, 1920: Frank M. Williams, William B. Landreth, F. P. Williams, E. A. Lamb, Thomas S. Bailey, C. H. Wood, H. W. Benedict, William Russell Davis, E. D. Hendricks, H. O. Schermerhorn, F. H. Macy, George H. Burgess, W. H. Mansfield, G. F. Stickney, H. D. Alexander, R. E. Phillips, James A. Galvin, John P. Newton, O. F. Bellows, C. H. MacCulloch, Noble E. Whitford, A. W. Conner, John A. O'Connor, Alexander Rice McKim, James P. McAvoy, W. J. H. Manning.

Section Action on Questionnaire

(*Concluded from p. 689.*)

Engineering Council at its meeting on Oct. 16, 1919, "expressed approval of the general principles underlying the proposal formulated by the Joint Conference Committee for the establishment of means for providing on a larger scale the functions which Engineering Council has since the summer of 1917 been performing for its Founder Societies."

The board of directors of the American Institute of Electrical Engineers has "Voted: that the report [of Joint Conference Committee] be endorsed and referred back to the institute's three representatives on the Joint Conference Committee for such action, in cooperation with the representatives of such other societies as endorse the report, as may be necessary to put the recommendations into effect."

The council of the American Society of Mechanical Engineers acting under the authority given it by the Annual Meeting of the society held in December, 1919, "Voted: that the council of this society approves and adopts the report of the Joint Conference Committee and instructs its representatives to immediately start work to carry out the recommendations."

The Annual Meeting of the American Institute of Mining and Metallurgical Engineers, held Feb. 17, 1920, unanimously adopted the following resolutions: "Resolved, that the American Institute of Mining and Metallurgical Engineers, assembled at its annual meeting approves in principle the report of the Joint Conference Committee and authorizes its representatives on that committee to act with that committee in calling a meeting for the organization of the representative engineering body provided for in said report."

At a joint meeting of the governing bodies of the member-societies of Engineering Council (American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, American Society of Mechanical Engineers, American Institute of Electrical Engineers, and American Society for Testing Materials), the trustees of the United Engineering Society and the members of Engineering Council, held in the Engineering Societies Building, Jan. 23, 1920, the following resolution was unanimously adopted:

"WHEREAS, This conference of national engineering societies has considered the recommendations of the Joint Conference Committee of the four Founder Societies, therefore be it

"RESOLVED: That the conference adopts in principle that report and requests the Joint Conference Committee to call, without delay, a conference of representatives of national, local, state and regional engineering organizations to bring into existence the comprehensive organization proposed."

The Joint Conference Committee met in Philadelphia on March 12 and 13, 1920, and arranged to call an organizing conference in Washington, D. C., June 3-4, 1920.

The following local engineering organizations have taken favorable action on the Joint Conference Committee Report:

Engineers Club of Philadelphia, with its eleven affiliated organizations.

The Washington Society of Engineers.

The Cleveland Engineering Societies.

The Associated Engineering Societies of St. Louis.

The Engineers Club of Columbus.

The fundamentals, covered by the questions on which the members of the American Society of Civil Engineers are now voting, have a vital bearing on the future of the society.

It is, therefore, the imperative *duty* of each member of the society to vote.

Any member of the American Society of Civil Engineers who has misplaced his ballot or desires to change his vote may obtain another ballot on application to the secretary of the society. This ballot closes, 12 o'clock noon, April 14, 1920.

RICHARD L. HUMPHREY,
Chairman, Joint Conference Committee of the four Founder Societies; Chairman, Conference Committee of the American Society of Civil Engineers; Member of Committee on Development of the American Society of Civil Engineers.

Philadelphia, March 29, 1920.

A. A. E. Has 14,620 Members

The American Association of Engineers had 14,620 members and 4,820 applications pending on March 24.

Washington Briefs

Colonels Thomas Rees and William Kelly have been nominated to be members of the California Debris Commission. The Military Affairs Committee has reported unanimously in favor of their confirmation.

The Senate has confirmed the promotion of the following officers of the Corps of Engineers: Herbert Deakyne to be Colonel; Spencer Cosby to be Colonel; George B. Pillsbury to be Lieutenant-Colonel; Gustave R. Lukesh to be Lieutenant-Colonel.

As reported to the Senate, the Agricultural appropriation bill carries $450,000 for the construction and maintenance of roads, trails, bridges, fire lanes, telephone lines, and other improvements necessary for the protection and development of national forests. This is an increase of $50,000 over the amount allowed in the bill which passed the House.

A total of $540,220 is allowed the Bureau of Public Roads in the Agricultural appropriation bill as reported to the Senate from its Committee on Agriculture. This is $49,600 more than was carried by the bill recently passed by the House.

Panama Slide Delays Ships

A recent report of Governor Harding of the Canal Zone to the War Department states that a movement of the Cucaracha slide in the canal, which occurred March 12, will cause intermittent obstruction to shipping for several weeks to come. The slide on the night of March 12 held up six ships of more than 25 ft. draft, but permitted the passage of six other ships drawing 22½ ft., and less. Further slides were anticipated in the Governor's report. The Cucaracha slide is on the east side of the canal, immediately south of Gold Hill.

Labor Proposes Broad Economic Program

In a recent issue of the *American Federationist* Samuel Gompers sets down in detail the broad economic program that the American Federation of Labor is setting for itself. It proposes to attain its end through active efforts to send to Congress and other legislative bodies men who are favorable to the program.

The program is long and comprehensive. It includes Federal licensing and control of all corporations organized for profit, legislation that would force into use agricultural land now uncultivated or cultivated by others than the owner, "organization and use of credit to serve production needs, and not to increase the incomes and holdings of financiers, control over credit capital taken from financiers and vested in a public agency able to administer this power as a public trust in the interests of all the people," Government operation of all wharves and docks connected with public harbors, and Government ownership and operation of all water powers over which they have jurisdiction.

Toronto Contractors Won't Submit Checks on Private Work

The General Contractors Association, operating as a section of The Builders Exchange of the City of Toronto, has adopted the following resolutions which have been forwarded to all architects and engineers in the city:

"(a) The members of this association decline to submit competitive bulk tenders on work for which the architect or engineer is at the same time taking separate tenders by trades.

"(b) The members of this association refuse to supply certified checks when tendering on private competitive work.

"(c) The members of this association decline to furnish detailed unit prices or subsidized estimates on new work until they have been informed that, providing such subdivisions and units are satisfactory, the work in question will be awarded to them."

The association also drew attention to the advisability of getting as much new work as possible under way before spring, since there would undoubtedly be an extensive building program this summer and since prices of material are still steadily rising.

Portland, Ore., Considering Waterfront Improvement

As to the result of a report on waterfront conditions submitted to the commissioner of public works by the city waterfront committee, the city council of Portland, Oregon, has authorized the preparation of plans for improving 5,300 ft. of the west side of the Willamette River and relieving traffic congestion in the waterfront district. The work will be in the hands of O. Laurgaard, city engineer, who is to work in conjunction with the county commissioners and the dock commission.

The report on which this action was based proposed that the city acquire the water front from Glisan to Jefferson Streets, build a sea wall and fill, raise bridge piers and approaches and improve the waterfront thus gained in a comprehensive way. The cost of land and improvements is estimated at $10,000,000. Structures on about 70 per cent of this frontage, the report states, have been condemned, recommended for condemnation or are in process of being wrecked.

The proposed improvements would include a terminal for passenger steamers, a terminal for interurban electric railways, the widening and improvement of the street along the waterfront, grade separation and street rearrangement on bridge approaches, and a public market. A feature of the proposed passenger steamer terminal would be space where about 5,000 automobiles could be stored by business and professional men, the purpose being to relieve street congestion.

Chamber of Commerce, U. S. A., Annual Meeting April 27-29

The eighth annual meeting of the Chamber of Commerce of the United States will be held in Atlantic City, N. J., April 27-29. According to announcement it will be a convention devoted entirely to the subject of increased production, which will be discussed in the following subdivisions: governmental relations, transportation, internal finance, agriculture, labor.

North Dakota Engineers Elect Woman as President

The election of a woman as president and discussion of highways, A. A. E. amalgamation, the Jones-Reavis bill and the division of authority in sanitary work, featured the twelfth annual meeting of the North Dakota Society of Engineers, held at Grand Forks, N. D., on March 10 and 11. Esther M. Jack, city engineer of Williston, is the new head of the organization. Engineers of the state highway commission and the Federal Bureau of good roads, contractors and representatives of material firms took part in the roads discussion. Recent instructions of the State Board of Health, construed as meaning to require the board's approval of details in design and construction of all water supply and sewerage systems had caused some friction in their implying a transfer of all responsibility and authority from the engineers to the board. A resolution was passed providing for a committee of engineers to confer with the State Board of Health in order to secure a revision of the rules.

Amalgamation with A. A. E. Proposed

Amalgamation of the society with the American Association of Engineers received extended consideration, only the absence of definite plans for the preservation of the present society's identity prevented a favorable decision. Accordingly, the society voted a resolution recommending that the society keep its organization intact, but that individual members who wish to should join the American association individually.

A resolution was passed approving the general idea of the Jones-Reavis bill for a national department of public works so far as it pertains to the bringing together of all the engineering and public works functions of the government, but recommending that the Bureau of Education be made a separate department, as provided in the Smith-Towner bill, rather than that it be transferred to the Department of Labor.

The officers elected were as follows: Miss Esther M. Jack, city engineer of Williston; vice-presidents, R. M. Stee and E. Ray Griffin; secretary and treasurer, Prof. E. F. Chandler, University, N. D. The next annual meeting will be held at Jamestown, N. D.

Extensive Engineering Projects in Uruguay Are Reported

A report just issued by the U. S. Bureau of Foreign and Domestic Commerce tells of many engineering projects now under consideration by the government and private interests of Uruguay for the development of natural resources and improvement of sanitary conditions. The biggest single project is an international power plant to be installed on the Uruguay River by Argentina, Brazil and Uruguay jointly, with guarantees for the equitable distribution of power to the three countries concerned. It is estimated that 2,500,000,000 kw.-hr. per annum could be developed by a hydro-electric plant on the site now being considered. The development contemplates the construction of two dams giving a total head of 77 ft. It is estimated that 419 miles of river, which is now inaccessible, could be opened to navigation and adjoining fertile zones irrigated.

Other projects for the development of water power are being considered. An official commission has prepared a plan for the irrigation of a 37,000-acre tract not far from Montevideo to serve as an experiment and an example. The potential water power in the water courses of Uruguay has been virtually untouched.

Fifteen cities of Uruguay, according to the report, are to install water supply and sewerage plants within the next few years. The pre-war estimates for this work totaled about $15,000,000. In 1916 the American engineers contracted for the installation of water and sewerage systems in three of the largest cities in Uruguay, at a cost of $5,000,000. That work was completed a year before the contract date, and the bonds have now been retired by the Uruguayan government. The City of Montevideo needs at the present time a large number of workmen's houses, ten new business structures, a hotel, an opera house, cold-storage facilities, and a number of factories. It has been estimated that the foregoing construction will total $16,300,000. The report goes on to say that within the next few years the Uruguayan government will need new and modern edifices to the value of $23,000,000.

The chief imports for such work will necessarily be steel and finishing materials.

Garford Has Transportation Bureau

The Garford Motor Truck Co. of Lima, O., has established a new department known as the transportation engineering department, the duties of which will be to gather authoritative information on motor truck operation. Investigation will be made of details entering into the operation and maintenance of trucks in use, including problems in loading and routing, method of delivery, housing, repairing and driving.

Detroit Contracts for 4 Miles of Steel Water Mains

An innovation in the method of providing watermain extensions in Detroit has been made by the Board of Water Commissioners by awarding the contract for furnishing material and constructing about four miles of 48-in. lockbar steel pipe with riveted end joints. This is a departure from the general practice of the Water Board and its engineers which has been to purchase cast iron water pipe and make extensions by day labor.

The pipe line for which contract has just been awarded is 20,930 ft. long. Constructed of sheet steel one-half inch in thickness and to be laid in a trench 6 ft. wide and from 9 to 13 ft. deep, it will be Detroit's first steel pipe of large dimensions. The contract price awarded is $31.94 per lineal foot, amounting to $668,504.20.

Los Angeles Municipal Cement Mill Will Make Potash

Some months ago the City of Los Angeles put on the market the cement mill at Monolith which it had built for making the cement used in the Los Angeles Aqueduct. However, it has been unable to sell or lease the plant for cement-making purposes, and the Board of Public Service has now leased it for a term of five years to be used for the production of potash. The city is to receive $22,500 per year rent, which is about 5 per cent of the minimum price placed on the plant by the city board.

Contract for Hartford-New London Trunk Line Let

C. W. Blakeslee & Sons, New Haven, Conn., was recently awarded the contract for the construction of 32.2 mi. of 18-ft. concrete highway on the Hartford-New London trunk line. The total contract price was $1,392,385.34, an average of a little better than $43,000 per mile. For bidding purposes the work was divided into four sections of approximately 8 mi. each, and but two bidders bid upon all four sections, the next highest to the successful bidder contracting to do the work for $1,818,582.96.

General Electric Co. Leases Remington War Plant

On March 17, 1920, the General Electric Co. leased, with option to purchase, the forty acre war plant of the Remington Arms Company at Bridgeport, Conn. The transaction involves about $7,000,000.

The plant was built in 1915-16. The space covered by the buildings is about 900,000 sq.ft., and the floor area in them is 1,555,257 sq.ft. The plant is expected to be in full operation by April 15, when the General Electric Co. will employ many thousand people, all of whom can be easily housed, as the facilities already exist. It is not yet known just what products will be manufactured in the new plant.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

TWELFTH NATIONAL CONFERENCE ON CITY PLANNING, 60 State St., Boston; Cincinnati, April 19-22.

NATIONAL FIRE PROTECTION ASSOCIATION, 87 Milk St., Boston; May 4-6; Chicago.

AMERICAN ASSOCIATION OF ENGINEERS; 63 E. Adams St., Chicago; May 10, 11, St. Louis, Mo.

AMERICAN WATER WORKS ASSOCIATION, New York City; Montreal, June 21-26.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Asbury Park, N. J., June 22-25.

AMERICAN PUBLIC HEALTH ASSOCIATION, Boston; San Francisco, Aug. 30-Sept. 3.

The Twelfth National Conference on City Planning will be held at Hotel Sinton, Cincinnati, April 19-22. The opening luncheon will be at noon, April 19. The first session will be held in the afternoon, devoted to reports of progress in city planning by Chicago, St. Louis, Pittsburgh, Detroit, Newark, Rochester, Dallas, Reading, Pa., and Flint, Mich. An evening session will take up Cincinnati's problems. At the morning session, April 20, railroad terminal problems will be reported upon. An automobile tour of the city is scheduled for the afternoon, and in the evening the presidential address will be delivered by Nelson P. Lewis, chief engineer, Board of Estimate and Apportionment, New York City. On April 21, there will be a morning session, on regional planning, followed by a civic luncheon; an afternoon session, on zoning, and the annual dinner at night, at which Dean Herman Schneider of the College of Engineering, University of Cincinnati, will be toastmaster. A business meeting will be held Thursday morning, April 22, after which the conference will be adjourned. Further information can be secured from the secretary, Flavel Shurtleff, 60 State St., Boston, Mass.

The Ontario (Can.) Good Roads Association has elected, for 1920, the following officers, all of Ontario: President, L. E. Allen, Belleville; honorary presidents, K. W. McKay, St. Thomas, and C. R. Wheelock, Orangeville; vice-presidents, T. J. Mahoney, Hamilton, and W. H. Brown, Chesley; secretary-treasurer, Hon. Geo. S. Henry, Todmorden; directors, F. A. Senecal, Plantagenet; J. A. Sanderson, Oxford Station; William Nugent, Belleville; W. H. Pugsley, Richmond Hill; T. L. Kennedy, Dixie; J. E. Jamieson, Singhampton; J. Currie, Strathroy; J. E. Waters, Niagara-on-the-Lake; and S. L. Squire, Toronto.

The Leonard Wood Engineers Club of Chicago has been organized for the purpose of furthering the candidacy for

the Republican presidential nomination of Major-General Leonard Wood. The officers elected are: President, Harold Almert; secretary, H. J. Gonden.

The Cornell Society of Civil Engineers will hold its regular spring meeting Friday evening, April 9, at 8 o'clock, in the fifth-floor assembly room, Engineering Societies Building, 29 West 39th St., New York City. Dexter S. Kimball, professor of machine design and industrial engineering at Sibley College, Cornell University, will be the guest of the evening. Prof. Kimball, who will become dean of the combined engineering colleges at Cornell beginning with the fall term of 1920, will speak on the future hopes and needs of the college. All of the mechanical and electrical engineers, and Cornell architects, are invited to meet with the civil engineers on this occasion. Refreshments will be served.

PERSONAL NOTES

J. S. BROYLES is now with W. S. Schulz, consulting engineer, Memphis, engaged on river terminal work there.

DANIEL W. MEAD, consulting engineer, Madison, Wis., has been engaged by the Grand River Drainage District of Livingston County, Mo., to act as consulting engineer in connection with the flood prevention plans worked out for the Grand River valley by the Morgan Engineering Co., Memphis.

E. W. LANE has secured a leave of absence from the Miami Conservancy District for a few months, during which time he will act as drainage census taker for Louisiana and other southern states. Mr. Lane is planning to leave for China in the early fall to study flood problems there, and also to deliver a course of lectures at Chinese universities.

COLONEL C. H. CRAWFORD, manager, Baldwin Locomotive Works, Rio de Janeiro, has been appointed South American representative of the American Association of Engineers. One of Colonel Crawford's functions will be to report on how the association can best serve Latin-American engineers.

WILLIAM L. LANCE, engineer, Spring Brook Water Supply Co., Wilkes-Barre, Pa., has resigned to become associated with John H. Lance, consulting hydraulic engineer, of that city.

EDWARD M. BURD and WILLIAM C. GIFFELS, formerly with the Consumers Power Co. of Michigan, have opened an office at Grand Rapids to engage in the practice of civil engineering.

T. S. BRINDLE, Ashland County, Ohio, has been appointed chief engineer, Ohio State Highway Department. He succeeds H. D. Bruning, resigned.

L. G. LENHART, civil engineer, formerly employed in the office of C. W. Hubbell, consulting engineer, Detroit, and on the investigations of the International Joint Commission, has been appointed city engineer of Pontiac, Mich.

FRANK L. WEAVER, formerly professor of civil engineering at Johns Hopkins University, and who served as captain of the 305th Engineers, has become associated with C. W. Hubbell, consulting engineer, Detroit, Mich.

C. PERRY PRANN, assistant in the city engineer's office, New Haven, Conn., has been appointed city engineer of New Britain, Conn.

D. Q. MCCOMB, recently highway engineer, U. S. Bureau of Public Roads, has resigned to accept an appointment as division engineer, Tennessee Highway Department.

J. J. GAULT has resigned as assistant engineer, maintenance-of-way, Chicago & Alton R.R., to take a position as engineer with Frank Lewin, builder, Chicago.

PROF. WALTER EDWARD MCCOURT, head of department of geology, Washington University, has been appointed dean of the schools of engineering and architecture of the university. He succeeds Alexander Suss Langsdorf, formerly dean of the scientific schools, who will leave the university in June to become production manager of the Crunden-Martin Mfg. Co.

E. S. CHASE, assistant sanitary engineer, New York State Department of Health, has resigned to accept a position with Metcalf & Eddy, consulting engineers, Boston, Mass.

SHELTON DAWSON has been appointed city engineer, Charles City, Iowa, succeeding the late W. S. Beattie.

CLIFFORD PAGE, recently assistant city engineer, Grand Rapids, Mich., who has been in Mexico for several months, has returned as acting city engineer. Mr. Page assumes the duties of city engineer in the absence of G. J. Wagner, at present on an indefinite leave of absence.

J. T. HURD, engineer, Chippewa Falls, Wis., has been appointed city engineer, Eau Claire, Wis., succeeding Mr. Garnock. Mr. Hurd will continue to act as consulting engineer for Chippewa Falls until another appointment is made.

G. M. JOWERS has been appointed engineer of Val Verde County, Tex.

ROSS J. BUCK, assistant city engineer, Indianapolis, has been engaged as city engineer, Muskegon, Mich. He succeeds C. L. Nelson.

E. M. HASTINGS, formerly resident engineer, Richmond, Fredericksburg & Potomac R.R. Co., has been appointed principal assistant engineer of that railroad.

A. TRAVERS ELWELL, consulting engineer, after spending ten years in South America, engaged in engineering work, has returned to this country and opened an office at 61 Broadway, New York, specializing as consulting engineer on South American engineering projects.

FREDERICK J. BASTABLE, assistant superintendent, Department of Public Works, Rochester, N. Y., died at his home in that city, Feb. 19 at sixty-two years of age. Mr. Bastable had been connected with the department for the past fifteen years.

R. F. RAGLAND, recently discharged from the Army as captain of Engineers, has opened an office in Livingston, Park Co., Mont., where he will engage in a general engineering and contracting business.

GEORGE GRUPE, formerly superintendent of water-works at Cleburne, Tex., has been appointed city manager of Brownsville, Tex.

THEODORE G. KITCHEN, city surveyor of Lambertville, N. J., has resigned his position in order to engage in private engineering work.

J. RUSSELL ELLIS, recently first assistant engineer, Missouri State Highway Department, has joined the staff of Winston Lee Winters, civil and hydraulic engineer, Fort Smith, Ark., as principal assistant engineer.

H. ELTINGE BREED, consulting highway engineer, New York City, has been placed in charge of the courses in highway engineering at the School of Applied Science, New York University. Mr. Breed served several years on road and canal work in New York State, was chief engineer of the Coleman du Pont road in Delaware, and more recently was first deputy highway commissioner of New York State.

COL. F. M. GUNBY, formerly associated with Charles T. Main, of Boston, and during the war head of the Engineering Branch of the Construction Division of the Army, has renewed his connection with the above-named firm as engineering manager.

EMORY E. BRANDOW, formerly bridge engineer, New York State Highway Department, has been appointed bridge engineer of the Pennsylvania State Highway Department.

MAJOR CURTIS W. OTWELL, formerly of the 319th Engineers, U. S. Army, has been transferred from Vicksburg, Miss., to Wheeling, W. Va., where he will be in charge of the local U. S. Engineer office. He succeeds Lieutenant-Colonel George P. Howell, recently assigned to the department of the southeast, with headquarters at Charleston, S. C.

CHARLES H. RESTALL, civil engineer in charge of construction for the F. F. Johnsberg Co., Boston, has been appointed chief engineer of the department of streets and engineering of that city.

R. P. FORSBERG, formerly assistant engineer, Pittsburgh & Lake Erie

R.R., has been appointed principal assistant engineer of that road, with headquarters at Pittsburgh.

MAJOR JOHN A. GRIFFIN, who was with the 316th Engineers in France, has been elected city engineer by the Board of Public Works of Los Angeles, Cal., to succeed the late A. C. Hansen. In 1903 he joined the staff of the city engineer of Los Angeles, and, except for the period of his service in the Army, has been employed there since that time.

CLIFFORD RICHARDSON, consulting engineer, New York City, will deliver a paper on dust prevention at a congress to be held this month at Monaco.

COLONEL WM. KELLY, formerly with the 117th Engineers, A. E. F., has arrived in San Francisco, where he succeeds Lieutenant-Colonel L. H. Rand in charge of inland waterways, U. S. Engineer Office.

OBITUARY

A. L. ORMAY, chief of the illustration department of the McGraw-Hill Co., died in Brooklyn, on March 23. He was born in Kassa, Austria-Hungary, in 1881. In 1907, he entered the drafting department of *Engineering News*, then in charge of Charles W. Reinhardt, where he remained for three years. During that time, although handicapped by lack of knowledge of English, he made such progress that when the late John A. Hill, president of the Hill Publishing Co., decided, in 1910, to install a drafting department for his publications, he asked Mr. Ormay to assume charge of it. When the McGraw and the Hill publishing companies consolidated, in 1917, his responsibility was doubled, and he took charge of the preparation of the line and half-tone illustrations used in the ten McGraw-Hill papers. Mr. Ormay was the originator of what is known as the "Ormay Process," a combination of line work with screen shadings extensively used in making illustrations of machine tools. For the past two and a half years, in addition to his supervision of the McGraw-Hill illustrations, he had taught mechanical drawing at the Mechanics' Institute. Although Mr. Ormay's artistic and executive qualifications had developed to a degree well-recognized by both the readers and staffs of the McGraw-Hill publications, yet his modesty grew apace, and he will remain in the memory of those who knew him as one of the strong, though unpretentious, workers in the upbuilding of the McGraw-Hill Co.

J. B. DAVIS, professor emeritus of geodesy and surveying at the University of Michigan, died at Bradentown, Fla., on March 10. He went to the university as instructor in engineering in 1872. He was later made assistant professor of engineering, and in 1891 became professor of geodesy and surveying, from which chair he retired, in 1910, as professor emeritus. He was born in Westport, Mass., in 1845.

IRVING MARSHALL ATKINSON, recently assistant division engineer of the California State Highway Commission, died, in San Francisco, March 1.

THOMAS P. STRACK, general contractor, engaged in municipal work in Cincinnati, and other cities in the Middle West, died recently in that city. In his twenty-five years as a contractor Mr. Strack handled numerous large contracts in Cincinnati, Dayton and other cities, among the more noteworthy of which was the building of the Ludlow Avenue viaduct in Cincinnati, the dredging of the Miami and Erie Canal from Miamisburg to Middletown, and the construction of the sewerage system in Cleveland. He was also at one time connected with the State Highway Commissioner's office at Columbus, Ohio.

F. A. MARTIN, assistant engineer of Shawnee County, Kansas, died, Jan. 29, in Waukesha, Wis., at the age of 32.

ALBERT KLEINSCHMIDT, a pioneer builder of Helena, Mont., and widely known in that state and Washington as the originator of the irrigation projects of those states, died at Berkeley, Cal., March 3. He was 76 years of age, and a native of Prussia. Mr. Kleinschmidt built the three largest irrigation canals in Montana, and fonded the Yakima project.

BUSINESS NOTES

THE F. C. AUSTIN MACHINERY CO., Chicago, has been incorporated to take over the business of the F. C. Austin Co., and the Municipal Engineering & Contracting Co., of Chicago, and the Linderman Steel & Machine Co., of Muskegon, Mich. It will retain the staffs of both companies and will have a greatly increased capacity for the manufacture of the Austin earth-loading and cement-working machinery. F. C. Austin retires from the active management, and B. A. Linderman assumes full control. The offices will be maintained in the Railway Exchange Bldg., Chicago.

THE ST. LOUIS STRUCTURAL STEEL CO., St. Louis, has assumed all of the assets and liabilities of the East St. Louis Bridge Co., East St. Louis, Ill., and all of the equipment of the Structural Steel Co., St. Louis. The plant and equipment of the East St. Louis Bridge Co. will be operated by the new company. George Stupp is chairman, board of directors; L. R. Gifford, vice-president and general manager, and J. G. Stupp, chief engineer.

THE PORTLAND CEMENT ASSOCIATION, Chicago, announces the following changes concerning several of its district engineers: C. N. Reitze, district engineer, Seattle office, appointed district manager, Pacific Coast offices at Seattle, Portland, San Francisco and Los Angeles; A. P. Denton, district engineer, Dallas office, assumes charge of San Francisco office as district engineer; Charles A. Clark appointed district engineer, Dallas office, to succeed Mr. Denton; H. E. Frech assumes charge of St. Louis office as district engineer.

THE DORR CO., engineers, New York City, has organized a sanitary engineering department to handle all matters, including engineering service, pertaining to the treatment of domestic sewage, waste waters of tanneries, glue, gelatine, milk products and corn products factories, cotton, silk and textile dyeing and finishing mills, canneries, brass, steel and rolling mills, paper mills. Colonel I. L. Reeves, C.E., formerly president of Norwich University, and more recently president of the A. E. F. University, in France, has resigned from the army to accept the management of the department. C. Lee Peck, industrial engineer, continues in charge of the research and development work, while R. H. Eagles, also of the Dorr Co. staff, will assume charge of the information and extension division.

HORACE D. KERR, engineer in charge, western technical and western service departments, Atlas Portland Cement Co., New York, has resigned to join the staff of the Nichols-Moore Co., general advertising agents, Cleveland.

JAMES STEWART & CO., INC., contractors, New York, branch offices Washington, Chicago, St. Louis, Houston and Salt Lake City, have established an office in the Buhl Block, Detroit, Mich., for the handling of construction work covering office buildings, railway buildings, manufacturing plants, grain elevators, heavy masonry, reinforced concrete, dredging and dock works. D. H. Sawyer, manager, Detroit office.

THE JOHN T. SCULLY FOUNDATION CO., Cambridge, Mass., announces that, due to development and scope of the company's business, the corporate name has been changed to The Scully Co. The personnel remains the same.

THE WHITING FOUNDRY EQUIPMENT CO., Harvey, Ill., announces that, after several years in its estimating and sales departments, C. H. Martin and Gustav Schirmer have been transferred, respectively, to the company's Pittsburgh and Detroit offices, to take up the duties of sales engineers.